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Chlorine Control Apparatus

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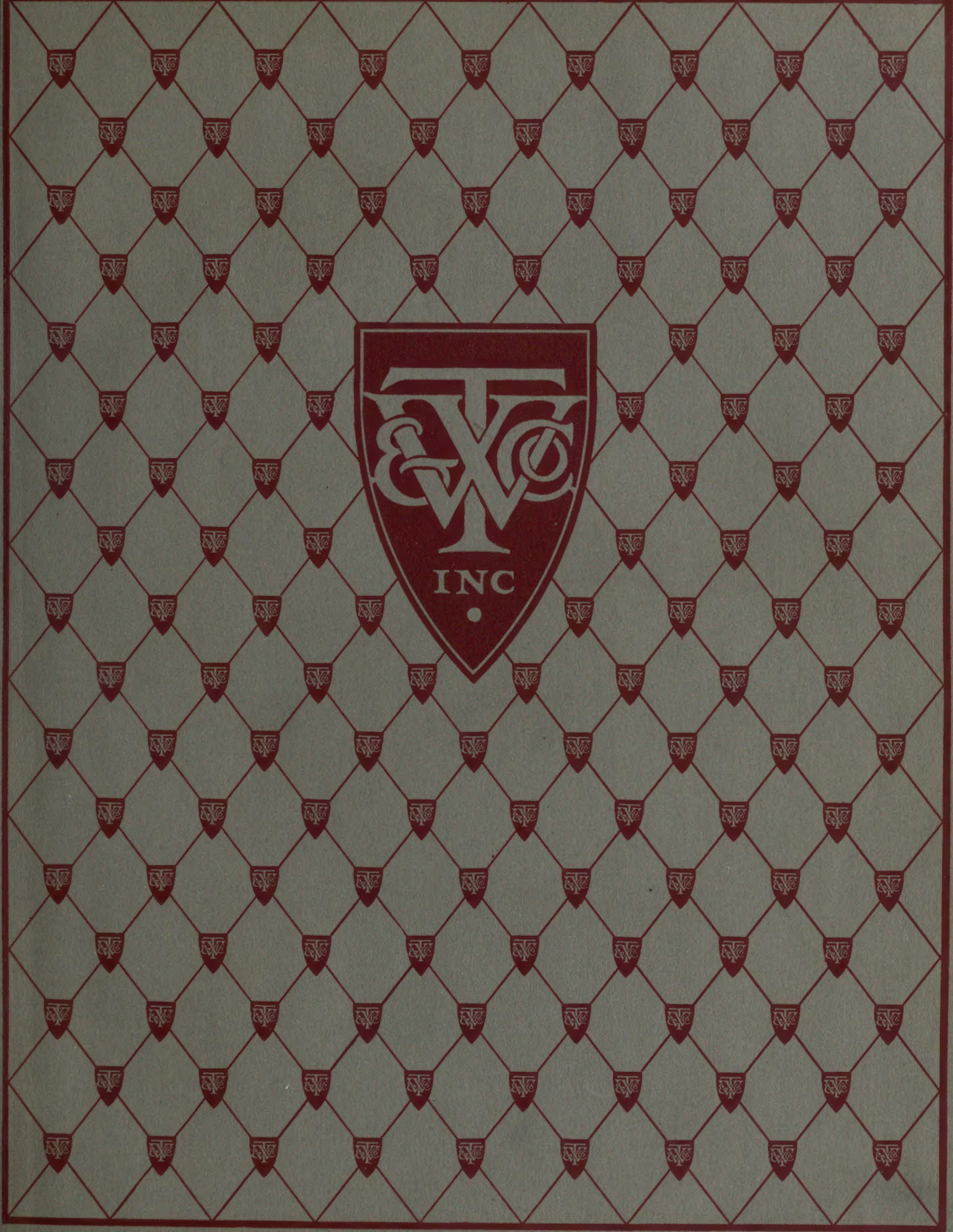
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Chlorine Control Apparatus

For Water and Sewage Purification

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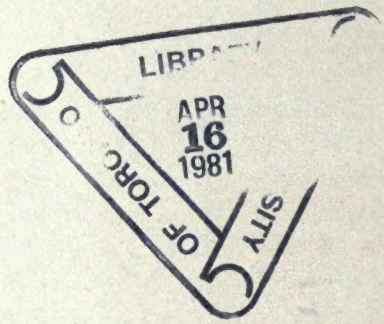

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DOUGLAS C. McMURTRIE
The ARBOR PRESS

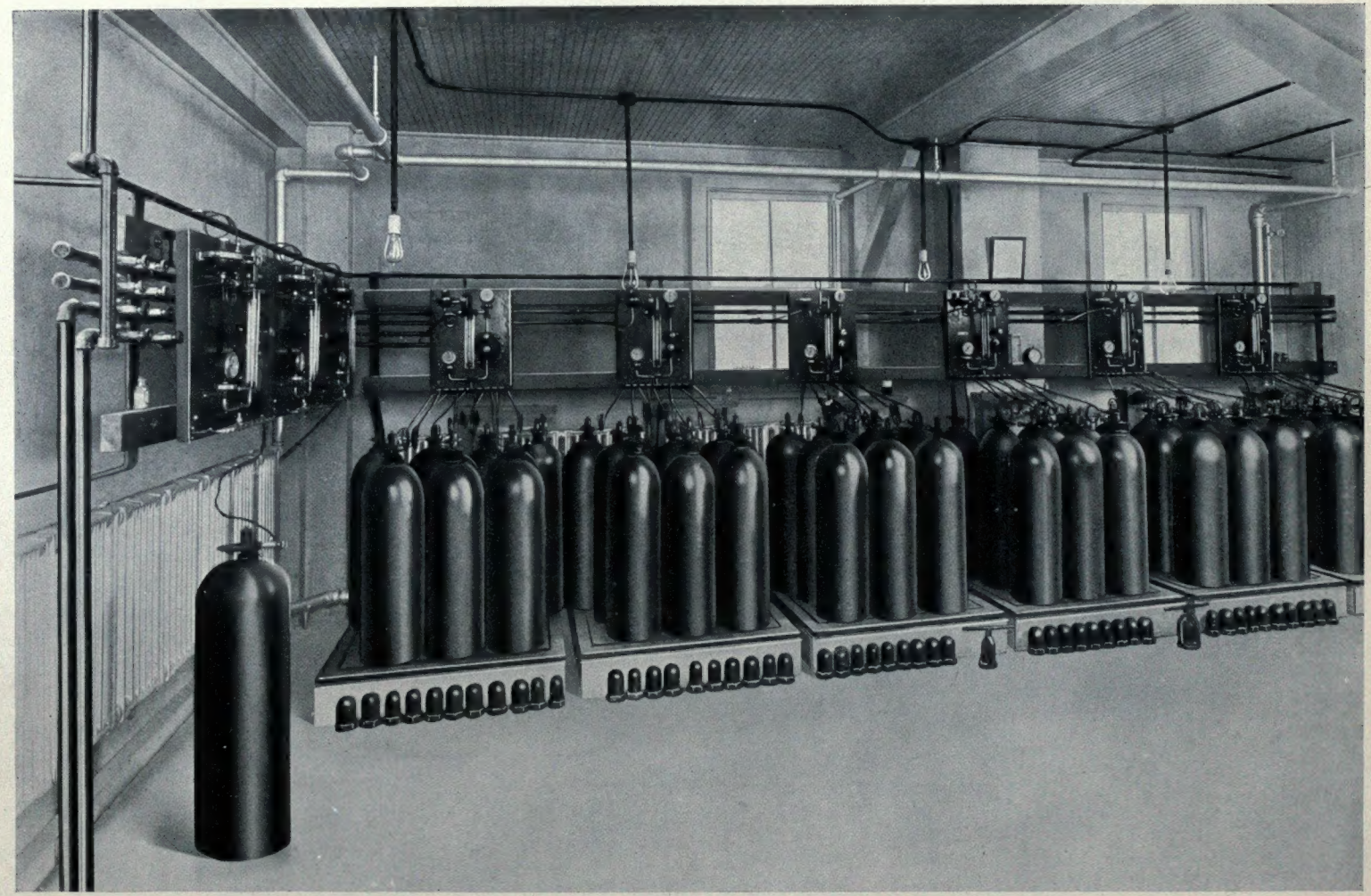
Foreword

IN submitting this new catalog for the consideration of engineers and others interested in water purification and sewage treatment, we wish to express our appreciation of the manner in which our first catalog was received by members of the profession, and of the many friendly comments and suggestions transmitted.

In this edition, many new types of apparatus are discussed and the theory and design of 'W & T' equipment more completely outlined.

The growth of this organization indicates that we have developed an apparatus of merit, and that the process of chlorination is one of the most important and potently active branches of sanitary science.

WALLACE & TIERNAN CO., INC.



THE LARGEST CHLORINATING PLANT IN THE WORLD. NINE 'W & T' CHLORINATORS INSTALLED AT DUNWOODIE, N. Y., TREATING 400,000,000 GALLONS OF WATER A DAY FLOWING TO NEW YORK CITY

Chlorine Control Apparatus

for Water *and* Sewage Purification

THE process of chlorination by the application of Liquid Chlorine is the most efficient means of water and sewage sterilization.

The application of liquid chlorine is, however, ordinarily fraught with difficulties arising from the very activity of the gas itself. Though very real, these difficulties are entirely overcome by the control apparatus manufactured by this Company —the only appliances on the market adequate to meet all requirements in handling chlorine in the liquid or gaseous state for the purification of water and sewage.

The consideration of engineers and others interested in water purification is invited to the details of design, the perfection of mechanical construction, and the variety of types available to meet varied needs and requirements. These matters are discussed fully in the following pages.

DEVELOPMENT

The process of chlorination, although used to some extent for over a score of years by various investigators and sanitarians, has come into extensive use on a large scale only during recent years.

The use of Liquid Chlorine is an evolution of the process of chlorination which began with the use of various chlorine compounds, notably sodium hypochlorite and calcium hypochlorite (chloride of lime).

The use of these compounds presented so many unsatisfactory features that they were rapidly supplanted when suitable apparatus was developed for the control of Liquid Chlorine.

Notable among the first large-scale attempts to sterilize water by the process of chlorination is that undertaken under the direction of Dr. A. C. Houston,[1] director of water examinations of the Metropolitan Water Board of London, England, in 1905. At that time sodium hypochlorite was applied to the Lincoln (England) Water Supply with gratifying results.

[1] Fifth Report of Royal Commission on Sewage Disposal, Appendix IV.

The first recorded attempt in this country to sterilize water on a large scale by the process of chlorination was made at the Bubbly Creek Water Filtration Plant, of the Union Stock Yards, Chicago, Ill. Calcium hypochlorite was used and the results accomplished justified the acceptance of the process as an important method of water purification.

Shortly after the Bubbly Creek experiments, chlorination plants using hypochlorite were installed for the water supplies of Jersey City, N. J., Scranton, Pa., and Johnstown, Pa. (It is gratifying to note that among the many installations of calcium hypochlorite plants that have been replaced by 'W & T' equipment controlling the application of liquid chlorine, are numbered the Bubbly Creek Water Filtration Plant, Chicago, Ill., and the water supplies of Jersey City, N. J., Scranton, Pa., and Johnstown, Pa.)

In 1910, the use of Liquid Chlorine was brought prominently into consideration following several independent experiments on the application of the pure chemical, and in these experimental efforts, Messrs. Wallace & Tiernan played an important rôle. Together, they developed apparatus necessary for the application of Liquid Chlorine, overcame tremendous difficulties, and presented to the field of sanitation an apparatus that has unquestionably demonstrated its value.

The perfection of the apparatus resulted in a rapid increase in the use of Liquid Chlorine, there being at this writing over three billion gallons of water sterilized per day by this method.

In the purification of sewage, Liquid Chlorine also plays an important part. Although Powers in 1888 at Brooklyn, N. Y., sterilized sewage by electrolytically prepared chlorine gas, it remained for Phelps (Prof. Earle B. Phelps) at the Massachusetts Institute of Technology Sewage Experiment Station, and at Red Bank, N. J., in 1907 to demonstrate that the process of chlorination was effective.

The present-day tendency in sewage treatment is toward the removal of the coarser solids by screening or sedimentation and the sterilization of the effluent by Liquid Chlorine. The installations of chlorine control apparatus treating sewage number many score.

LIQUID CHLORINE *vs.* CHLORIDE OF LIME

Liquid chlorine is a far more efficient and economical sterilizing agent than chloride of lime, and some of its specific advantages are herein presented.

In the first place, Liquid Chlorine is an absolutely pure chemical. It is usually placed on the market in small cylinders which require very little space for storing, while chloride of lime is very bulky.

The disagreeable odors and corrosive effects of chloride of lime are absent in the use of Liquid Chlorine, when controlled by efficient apparatus.

Chloride of lime deteriorates rapidly, whereas Liquid Chlorine retains its full efficiency indefinitely. This is one of the greatest advantages to be derived from the use of Liquid Chlorine, especially for small installations.

Under working conditions, due to unavoidable waste of bleach, one pound of Liquid Chlorine is equal in sterilizing value to from six to eight pounds of chloride of lime. The sterilization is also more uniform, better bacteriological results being obtained.

Water treated with Liquid Chlorine is less liable to have taste or odor, due to the more accurate control possible.

The Liquid Chlorine apparatus is far more compact than the installation for chloride of lime.

The Liquid Chlorine process is applicable under any conditions and all pressures. It is adapted to remote control. The gas can be controlled automatically.

Liquid Chlorine control apparatus requires little more than daily inspection. Apparatus for the application of chloride of lime requires constant attention to prevent clogging of orifices and to secure continuous service.

The saving accomplished by substituting Liquid Chlorine for chloride of lime is frequently in excess of fifty per cent.

THE FIELD OF CHLORINATION

The use of Liquid Chlorine is developing so rapidly and divergently that any definition of its scope must of necessity be incomplete. Mention may be made of its use in the sanitary field to sterilize water and sewage, industrial wastes and tannery effluents, of its use in the bleaching and manufacture of textiles, dyestuffs and other commercial products, and of its use in military fields, and as an antiseptic in surgery and hospital work. Chlorine gas is coming into use also in the disinfection of buildings and factories in place of fumigants.

WALLACE & TIERNAN CO., INC., manufacture apparatus for the application of chlorine in these various fields, the types of equipment used for the sterilization of water and sewage being described in this catalog. Those

interested in apparatus for industrial purposes and other uses are respectfully referred to our publications describing these equipments. Our Engineering Department is ready to give expert advice on any problems of chlorination, or in the measurement, control and proportion of gases.

CHLORINE MANUFACTURE

Chlorine is formed by the electrolytic decomposition of salt solutions, the moist chlorine gas evolved from the electrolytic cells being dried, and compressed into liquid in steel cylinders of approximately one hundred pounds capacity. The gross weight of the container and the contents is less than two hundred pounds. Recently containers of one hundred and fifty pounds capacity with a gross weight of 275 to 300 pounds have come into considerable use.

PRINCIPLE OF APPARATUS

The function of a chlorinator is to regulate the flow of chlorine gas and apply it where needed.

Upon releasing the pressure in the cylinder, the chlorine changes from a liquid to a gas. The gas passing from the cylinder is controlled and measured by the apparatus and introduced into the water or sewage in proper proportion to effect sterilization.

There are two general types of apparatus, one by which the chlorine gas is introduced directly into the water or sewage and the other by which the chlorine gas is first dissolved in a small quantity of water and the resulting chlorine solution piped to the point of application. The first type is called a direct or dry feed and the second type a solution or wet feed.

Each general type is furnished for manual, semi-automatic or automatic control.

A manually controlled apparatus with a given setting will feed chlorine at a definite rate until the setting is changed by hand.

A semi-automatic chlorinator functions in the same manner except that it starts and stops automatically with the flow of water or sewage.

An automatic apparatus starts and stops with the flow of liquid treated and varies the flow of chlorine in direct proportion to the flow of water or sewage.

ADVANTAGES IN CONSTRUCTION

There are many advantages in the construction and design of all 'W & T' apparatus to which special attention is directed.

Simplicity in Design. There are no moving parts to get out of order or adjustment.

Compactness. Shipment by express is easy and inexpensive. The apparatus can be sent completely assembled, ready for operation. Installation is a matter of hours and minutes, not of days and weeks. The apparatus may be installed at any convenient point on the premises and the chlorine piped to point of application, even as far as two hundred yards.

Portability. The average weight of the apparatus is less than one hundred pounds.

Meters Hydraulic in Principle. All chlorine meters operate on the hydraulic principle, as discussed on page 11. There are no moving mechanical parts to cause friction, wear or strain. If the meter indicates at all, it indicates correctly.

Empirical Calibration. The chlorine meter on each apparatus is empirically calibrated, and then checked during the efficiency test.

Visibility. All chlorine flow meters and orifices are entirely visible, making it possible to actually see at all times that the meter is working perfectly in each detail, and is clean and free from deposit.

Dry Control Parts. All control parts of the apparatus are kept perfectly dry, thus avoiding corrosion—for it is only in the presence of moisture that chlorine is so extremely corrosive.

Constant Drop in Pressure. Each type of apparatus has a differential pressure reducing valve which maintains a constant drop in pressure across the chlorine control valve. This produces a constant flow of chlorine for any setting of the control valve regardless of varying pressures in the chlorine cylinders or of varying back pressures from the water being treated. A change in static head in the chlorine apparatus or in the water being treated in no way affects the predetermined drop in pressure across the control valve. This drop is about a pound and allows a considerable opening of the control valve for comparatively low flows of chlorine, minimizing the possibility of stoppage.

Special Materials. Special metals and materials, such as platinum, silver, tungsten, monel, and alloys particularly adapted for chlorine control are used where suited to the needs in question.

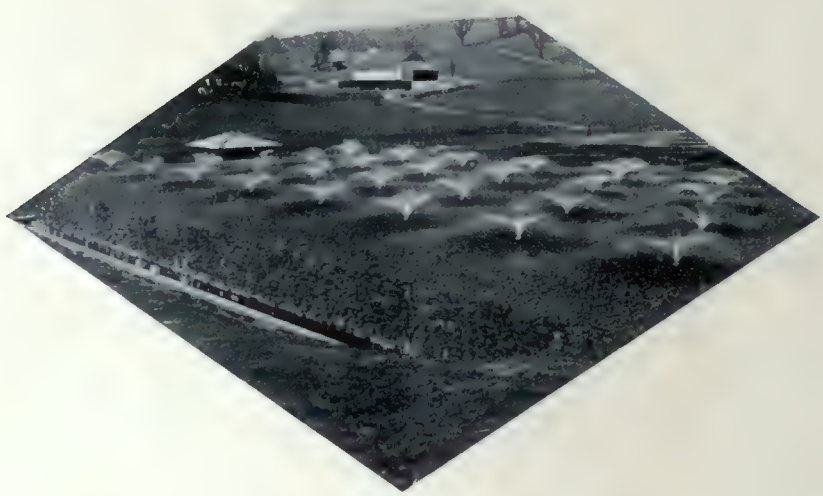
Finish. Parts are finished in silver plate and black enamel. Standard equipment is mounted on polished mahogany panels or in mahogany cabinets.

Interchangeable Parts. The apparatus is built on the unit system and all parts are interchangeable.

Workmanship. The highest class of workmanship is employed in making all parts of the apparatus.

TESTING

We maintain a fully equipped testing laboratory. Each unit of the equipment is tested before and during assembly. The completed apparatus is given a test run with chlorine under conditions analogous to actual installation. These tests are conducted by experts who have installed and operated chlorinators at water and sewage plants.



Measurement of Chlorine

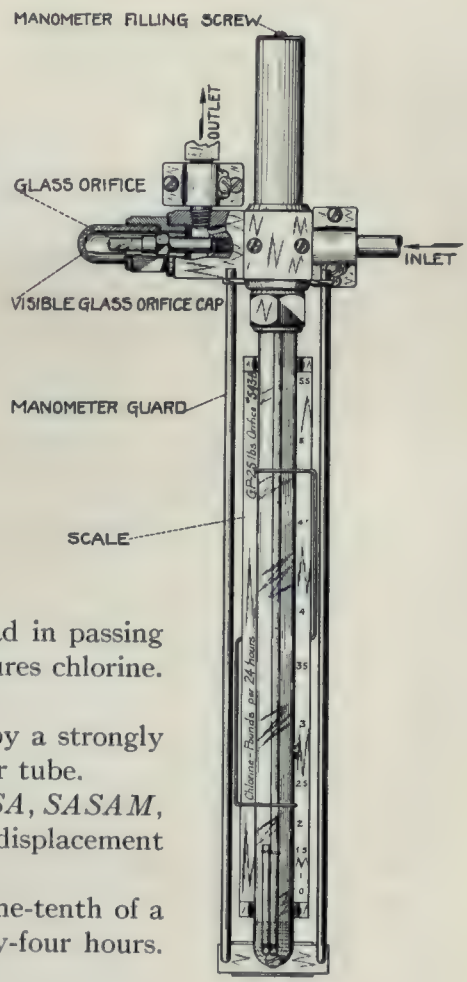
MOST essential as a feature in a chlorine control apparatus is a simple and accurate flow meter. It is in the means adopted to measure the flow of chlorine that our apparatus excels.

With the exception of types *MSA*, *MSAM*, *ASA*, *ASAM*, *SASA*, *SASAM*, all of our apparatus is equipped with 'W & T' manometer flow meter, connected to a visible glass orifice through which the chlorine passes.

The illustration on this page indicates the construction of the manometer.

The chlorine passes through the visible non-corrodible glass orifice, the drop in pressure being indicated on the manometer, to which a scale reading in pounds of chlorine per twenty-four hours (or other convenient unit to suit purchaser) is attached.

The scale is carefully graduated to correspond with the calibrated orifice, and so accurate are these orifices that although the meters are guaranteed to indicate the flow of chlorine within 4% of the actual amount, they are usually found to indicate with an error of less than 1%.



Just as water is measured by the loss in head in passing through an orifice, so 'W & T' apparatus measures chlorine. It is scientific, accurate and dependable.

The amount of chlorine flowing is indicated by a strongly defined column of liquid in the inner manometer tube.

With types *MSA*, *MSAM*, *ASA*, *ASAM*, *SASA*, *SASAM*, either our pulsating or our bubbling type of displacement meter is used.

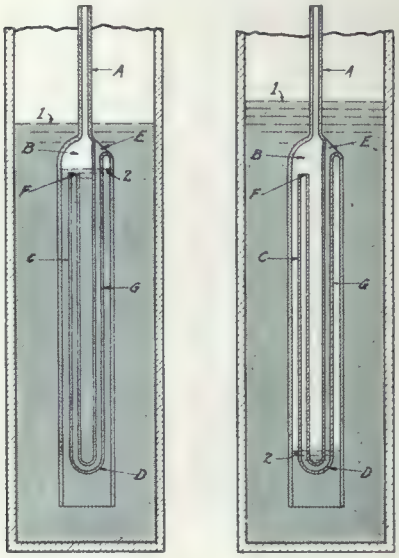
The pulsating meter has a capacity of from one-tenth of a pound to twelve pounds of chlorine per twenty-four hours.

The bubbling meter has a capacity of from one one-hundredth to one and two tenths pounds per twenty-four hours.

The inverted syphon pulsating meter is shown in the sketches *X* and *Y*.

It is composed of an inverted glass syphon within a cylindrical glass meter.

View *X* shows the water level *2* in the meter at the beginning of the pulsation, and view *Y* shows the water level *2* just before the syphon *C–G* breaks at *D*, which completes one pulsation of the meter.



X Y

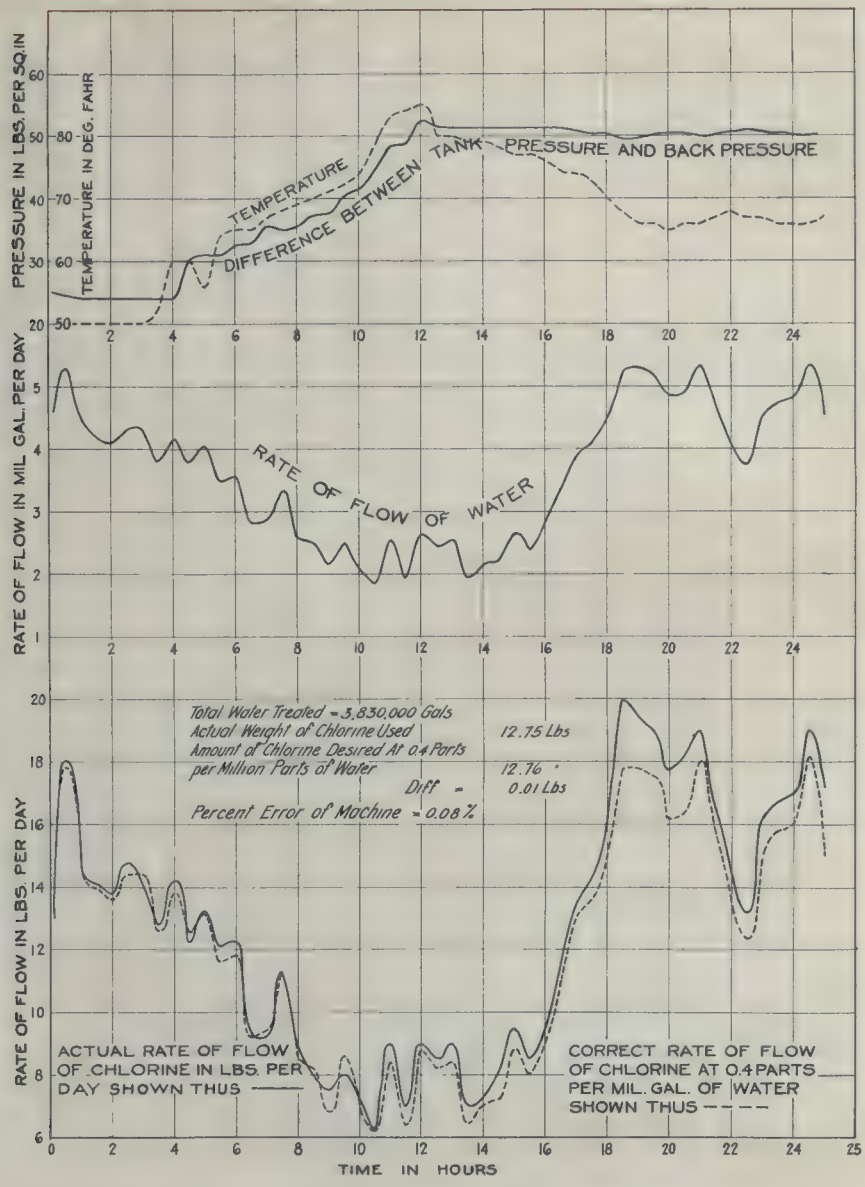
Its operation is as follows: When the downward flowing gas in *A* reaches the point *D*, it will rush up through the tube *G* of the syphon, and the bell or compartment *B* will refill with water up to the upper end of *C*. This completes one pulsation or measure of the meter, and the amount of gas delivered by this one pulsation is, of course, the capacity of the compartment *B* between the points *F* and *D*.

This is a volumetric meter, hydraulic in principle, and if it operates at all, it must operate correctly.

All openings are large so that there is no danger of stoppage. All parts are of glass, which is in no way affected by the chlorine solution. Furthermore, this plan of construction enables the attendant actually to see the chlorine flowing, no matter how small the amount. This point is essential in reliable chlorine control work.

The amount of chlorine flowing may be determined by counting the number of pulsations of the meter per minute and consulting the chart of operation.

This bubbling type of meter is so constructed that the chlorine is liberated in bubbles of predetermined capacity, the rate of flow of chlorine being determined by the number of bubbles per minute. These meters are most carefully calibrated and are extremely accurate.


PRESSURE IN LBS. PER SQ. IN
TEMPERATURE IN DEG. FAHR
TEMPERATURE
DIFFERENCE BETWEEN TANK PRESSURE AND BACK PRESSURE
RATE OF FLOW IN MIL. GAL. PER DAY
RATE OF FLOW OF WATER
Total Water Treated = 3,830,000 Gals.
Actual Weight of Chlorine Used 12.75 Lbs
Amount of Chlorine Desired At 0.4 Parts per Million Parts of Water 12.76 "
Diff = 0.01 Lbs
Percent Error of Machine = 0.08%
RATE OF FLOW IN LBS. PER DAY
ACTUAL RATE OF FLOW OF CHLORINE IN LBS. PER DAY SHOWN THUS ——
CORRECT RATE OF FLOW OF CHLORINE AT 0.4 PARTS PER MIL. GAL. OF WATER SHOWN THUS – – – –
TIME IN HOURS

EFFICIENCY TEST ON CHLORINE APPARATUS, AUTOMATIC CONTROL

MADE MARCH 31, 1915, BY STAMFORD WATER CO., STAMFORD, CONN.

Chart of Operation

IN the treatment of water with chlorine, the quantities added are usually expressed in parts chlorine per million parts water by weight. Since a gallon of water weighs 8.3 lbs., one part chlorine per million parts water is equivalent to 8.3 lbs. chlorine per million gallons of water.

The chart of operation furnished with each apparatus provides a simple and accurate means for determining the number of pounds chlorine per 24 hours to add to any quantity of water to give a desired number of parts per million.

For example, it is desired to treat two million gallons of water with .24 parts chlorine per million parts water. From the intersection of the vertical line from the figure 2 at the bottom of the chart with the horizontal line from the figure .24 at the left side of the chart, follow the oblique line to the right hand side of the chart. The figure here is 4, which is the number of pounds chlorine necessary to add to two million gallons of water in 24 hours to give .24 parts per million.

These charts are made for any flow of water, and the graduations on the right and upper sides of the chart are the same as on the orifice flow meter of the apparatus.

When the siphon type meter is used, its rate of delivery is determined by the scale at the top of the opposite page, the pounds chlorine desired being read from left to right on the upper scale, and time per pulsation or measure of the siphon in seconds being read from right to left on the lower scale.

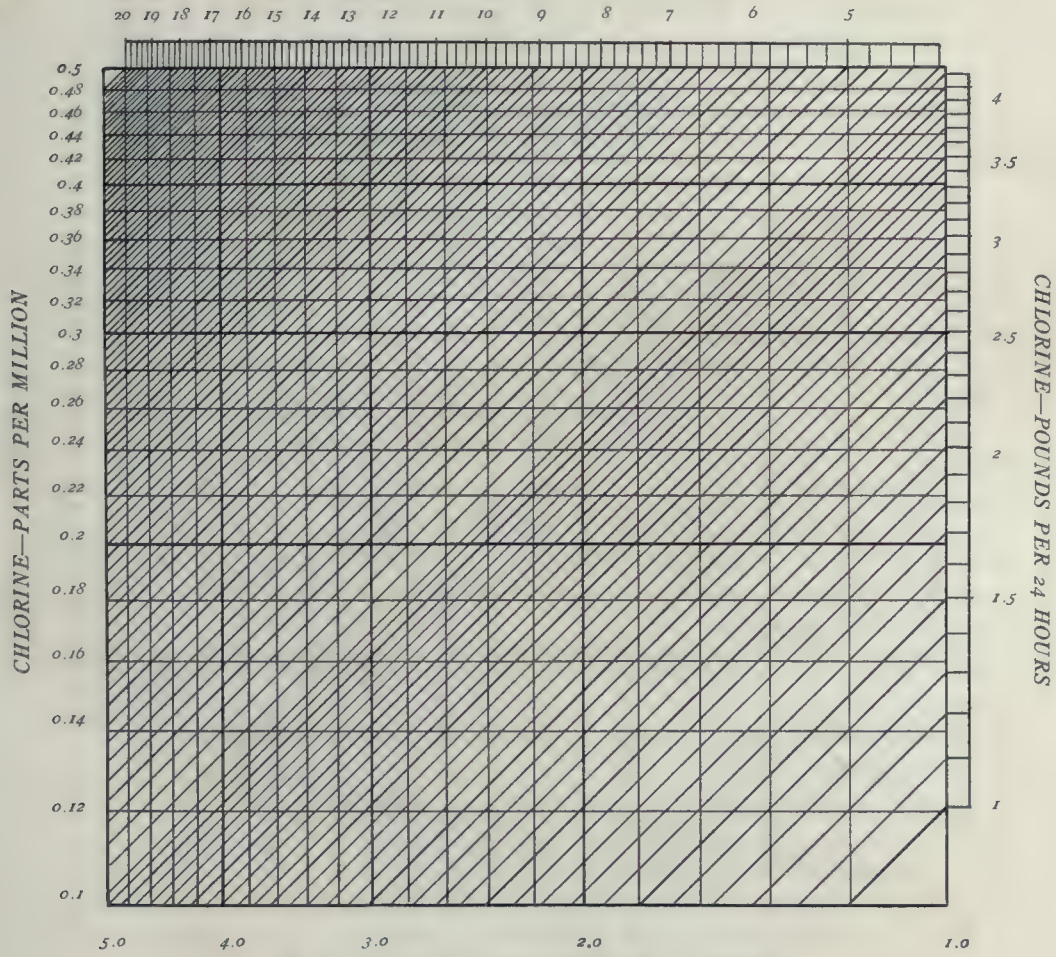
For example, it is desired to treat two million gallons per 24 hours with .24 parts of chlorine. Find on the chart as above described the number of pounds chlorine, which in this instance is 4. On the upper scale, reading from left to right, find the figure 4, and directly under it is the figure 5.7, which is the number of seconds for one pulsation or measure of the meter to give the required feed. This can be read in measures per minute by simply dividing 60 by 5.7, which gives 10.5, the number of measures per minute.

Any workman of ordinary intelligence can properly set the apparatus by means of this simple chart of operation.

CHLORINE—POUNDS PER 24 HOURS

SECONDS PER PULSATION

CHLORINE—POUNDS PER 24 HOURS



CHLORINE—PARTS PER MILLION

CHLORINE—POUNDS PER 24 HOURS

WATER—MILLION GALLONS PER 24 HOURS

The Chlorination of Water

POINT of application is of the utmost importance in the chlorination of water. The source of supply, method of treatment, distribution, and local conditions influence the point of application, and therefore the type of apparatus recommended.

On page 64 is a tabular summary of the conditions limiting the various types of apparatus. In endeavoring to select from this chart the type of apparatus best suited to local conditions, the following points should be borne in mind.

A raw, untreated water requires more chlorine for its proper sterilization than a filtered or clarified water.

If a coagulant is used, a saving in chemicals is sometimes effected by introducing the chlorine before the coagulating chemical.

With a filtered water, where possible chlorine should be applied after filtration rather than before.

Chlorine should be introduced as near to the inlet of the distributing system as possible to avoid pollution subsequent to chlorination.

A chlorine control apparatus should be installed in a substantial structure provided with heating facilities to insure a minimum temperature of 50° F.

The amount of chlorine required is dependent entirely upon the composition and quality of the water to be treated. We have found from general practice that a filtered water requires from 0.12 to 0.40 p.p.m.; spring or well water from 0.20 to 0.50 p.p.m.; and raw surface water from 0.30 to 1.00 p.p.m. (p.p.m=parts per million. One part per million [p.p.m] is equivalent to 8.3 pounds for each million gallons.) There are occasionally exceptional waters that require more chlorine than indicated by the foregoing, but they are unusual. It appears that surface waters in cold climates, such as Canada, in winter, require more chlorine than surface waters in warm climates.

We do not recommend that the application of chlorine to any water supply be based on the above figures as it is only by bacteriological examination of the treated water that the chlorine requirements can be determined.

Our Technical Publication No. 6 describes a simple and convenient equipment for making bacteriological examinations. This equipment should be a fundamental part of every water works.

The Chlorination of Sewage

DECIDING factors in the chlorination of sewage should be given the same careful consideration as in the case of water treatment. The point of application is of vital importance and is influenced by the other processes of treatment used.

Where local conditions will permit, the point of application should be where the suspended matter is a minimum and the dissolved oxygen a maximum. Due to the high organic content of sewage, it is desirable to have a minimum period of contact of fifteen minutes between the application of chlorine to the sewage and its discharge into a water course. A longer period of contact will often reduce the amount of chlorine required.

Sewage requires much larger amounts of chlorine than water, the rates of application varying from two to ten parts per million. This of course is only general and as in the case of water, the amount of chlorine needed can be determined only by bacteriological examination.

The saving in chlorine and consequent operating cost effected by installing automatically controlled chlorinating equipment, justifies its use in every sewage treatment works where the flow exceeds 200,000 gallons of sewage per day.

Manual Control, Solution Feed Chlorinator

TYPES *MSA* AND *MSAM*

APPARATUS of this type was developed for small installations requiring not more than twelve pounds of chlorine per twenty-four hours.

The chlorine gas from the containers passes through the compensator, regulated by the control valve, through the check valve and solution jar head, being measured by a pulsating or bubbling meter, into the chlorine solution jar where it is mixed with water; the water is introduced from the feed water supply line through the jet orifice in the solution jar head.

The chlorine solution formed in the solution jar passes through the solution tube and through the solution line to the desired point of application.

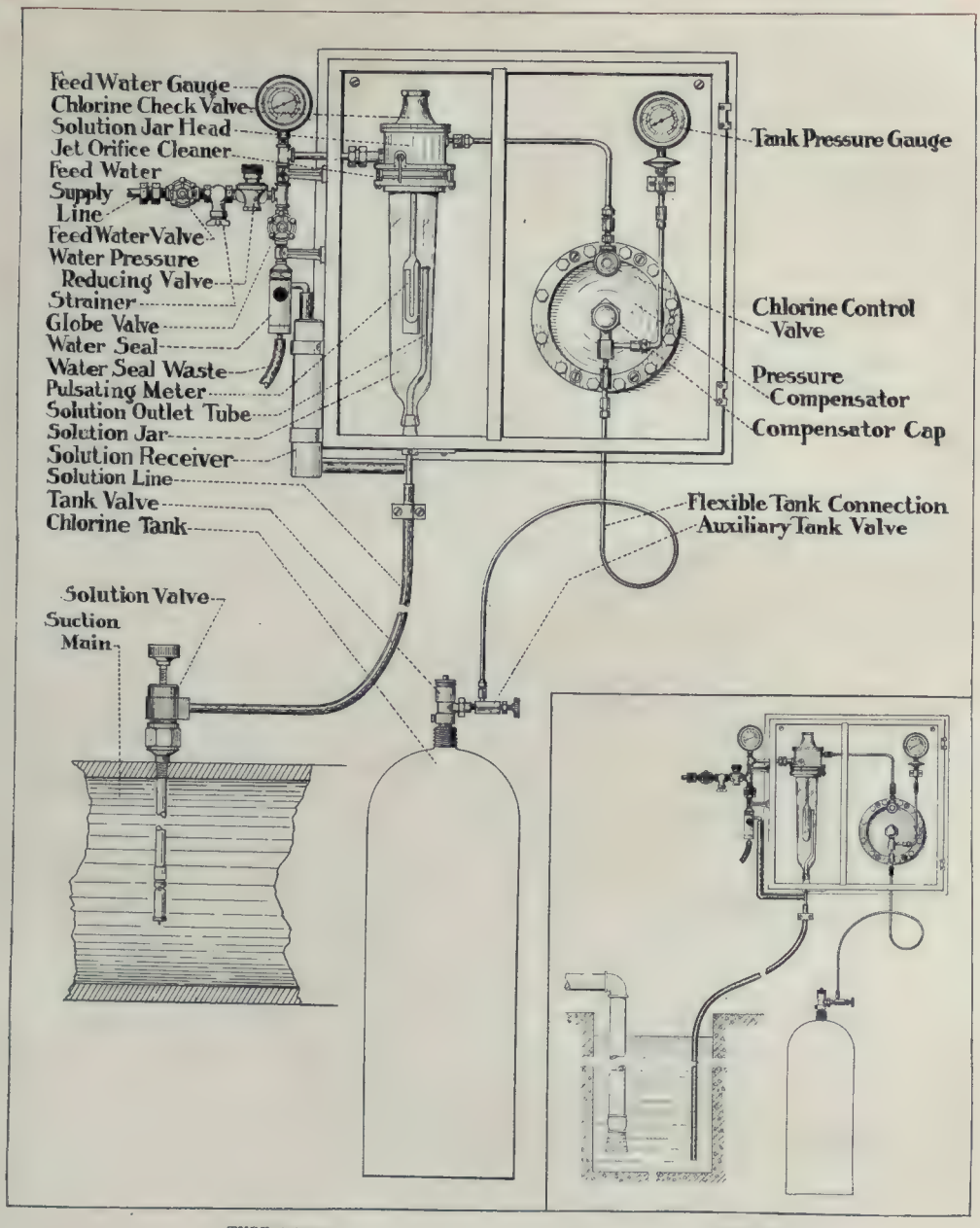
When the application is made in a pump suction main, a water seal is furnished to prevent air being drawn into the pump, make up water being furnished for the water seal. Where the suction varies, a solution receiver is furnished to stabilize the flow.

With the pulsating meter all flows of chlorine from one-tenth to twelve pounds per day can be accurately measured. The visible sight feed of this apparatus appeals to the water works attendant.

The capacity of the apparatus can be changed by the substitution of a bubbling type meter for the pulsating meter, so the minimum rate will be one-hundredth of a pound of chlorine per twenty-four hours, and the maximum one and two-tenths pounds. When it is considered that a flow of one one-hundredth of a pound of chlorine per twenty-four hours is equivalent to a flow of 0.000000116 pounds per second, distributed uniformly throughout the day, the sensibility of this apparatus is appreciated.

The chlorine solution is introduced in suction mains or other pipe lines not under pressure, through a chlorine solution valve of silver and vulcanite. When this valve is used the type is known as *MSAM*.

A solution valve is not required when application is made in an open body of water. Under such conditions, the apparatus is known as Type *MSA*.



TYPE *MSAM* TYPE *MSA*

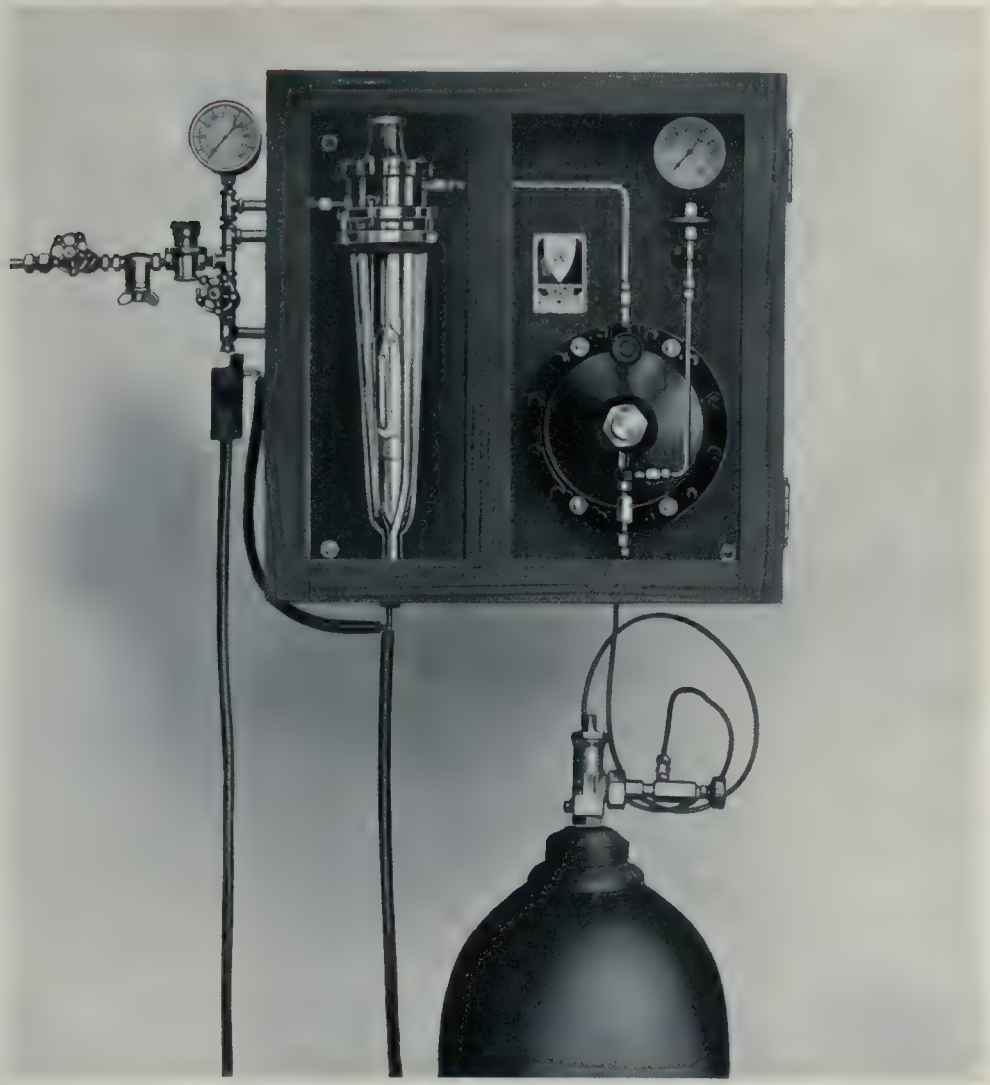
MANUAL CONTROL, SOLUTION FEED CHLORINATOR

Applicability of Types *MSA* and *MSAM*

This apparatus is applicable to any installation requiring not more than twelve pounds of chlorine per twenty-four hours, where the chlorine can be introduced in a pump well, pump suction main, gate chamber, or some other portion of the system where there is no positive pressure. It can be combined with our chlorine solution injector or chlorine solution pump for application against pressure.

There is required a water supply of approximately twenty gallons per hour with a pressure not less than fifteen pounds per square inch to operate this equipment. Higher pressures are regulated by the water pressure reducing valve on the feed water supply line.

It is desired frequently to install this type of apparatus in pumping stations where there are two or more pump suction lines. By using a split feed device of silver and vulcanite and a solution valve for each suction main, the chlorine solution can be divided and applied as desired. This increases the flexibility of the installation.



MANUAL CONTROL, SOLUTION FEED CHLORINATOR, TYPE *MSA*

Manual Control, Solution Feed Chlorinator

Types *MSB* and *MSBM*

THIS type of solution feed apparatus has been developed for use where more than twelve pounds of chlorine per twenty-four hours is required.

The chlorine gas from the containers passes through the compensator, regulated by the control valve, measured by the manometer flow meter as it passes through a visible glass orifice, to the chlorine check valve.

From the check valve, the chlorine passes into the solution jar. Water under pressure is introduced from the water supply line through a jet orifice into the solution jar, insuring complete absorption of the chlorine by the water. The solution is conducted through special tubing to the desired point of application.

The chlorine check valve prevents moisture getting back into the control mechanism. The solution jar being of glass, facilitates inspection and makes the solubility of the chlorine actually visible.

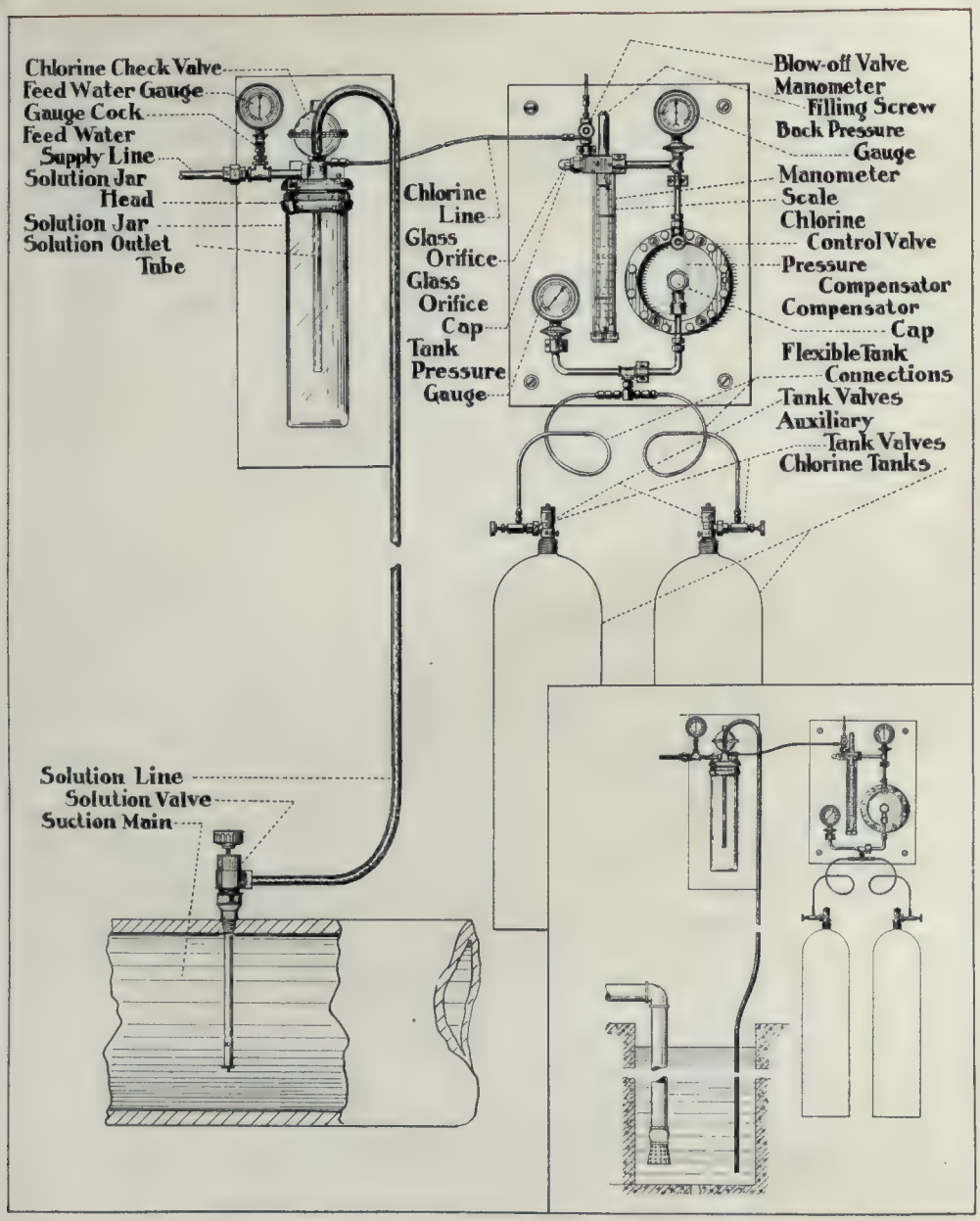
The chlorine measuring device and the absorption device are separate independent units. They may be located, either near together or apart as conditions of installation require.

This apparatus when used to introduce chlorine solution in an open body of water is known as type *MSB*.

For introducing the solution in suctions or other pipe lines not under pressure, a chlorine solution valve of silver and vulcanite is used and the equipment is known as type *MSBM*.

Applicability of Types *MSB* and *MSBM*

This apparatus is applicable on all flows of chlorine up to two hundred pounds per twenty-four hours, where it is possible to apply chlorine solution at some point in the system where there is no positive pressure, application being usually made in pipe lines, pump wells, suction lines, gate cham-



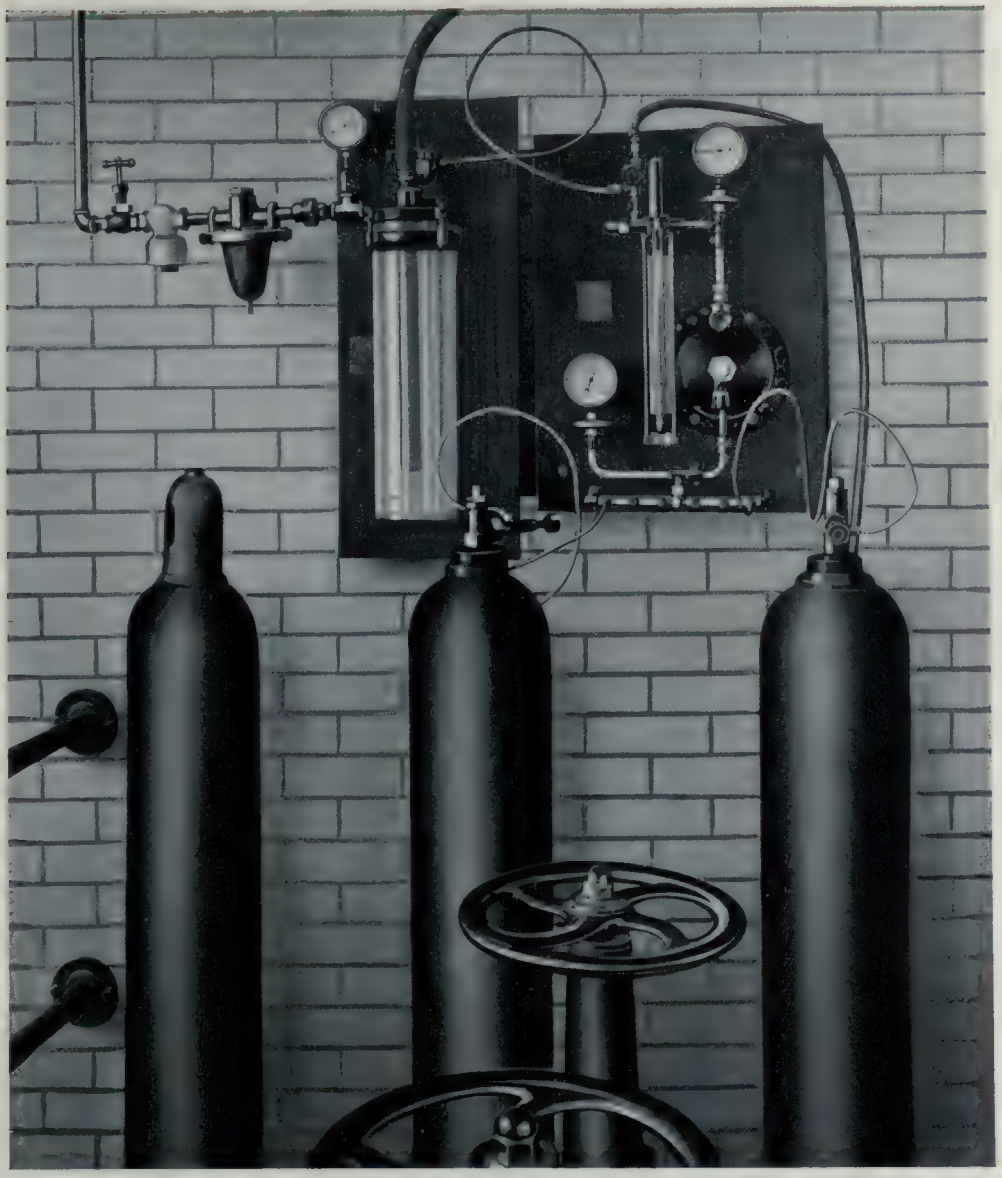
TYPE *MSBM* TYPE *MSB*

MANUAL CONTROL, SOLUTION FEED CHLORINATOR

bers, etc. It can be combined with our chlorine solution injector for application against pressure.

The most accurate range of the apparatus is from one to five; that is, the minimum flow should not be less than one-fifth of the maximum for which the apparatus is constructed.

This apparatus requires a water supply under a pressure of at least twenty pounds per square inch at a rate of fifty gallons for each pound of chlorine. A higher water pressure can be reduced by a regulating valve furnished with the apparatus when required.



INSTALLATION OF TYPE *MSBM* IN WATER PURIFICATION PLANT OF
BOTANY WORSTED MILLS, PASSAIC, N. J.

Manual Control, Direct Feed Chlorinator

TYPES *MDA* AND *MDAM*

DEVELOPED for the application of chlorine gas to water or sewage. The chlorine gas from the containers passes through the compensator, regulated by the control valve, measured by the manometer flow meter as it passes through a visible glass orifice, to the chlorine line and chlorine check valve. From the chlorine check valve the gas passes through pure silver tubing to the point of application, where it is dissolved and distributed by the chlorine diffusor.

The chlorine line conducting the gas from the chlorinator to the check valve may be of copper or galvanized iron piping. Chlorine gas does not attack these metals when dry and moisture is kept out by the check valve. The dry gas can be piped any distance up to five hundred feet.

The diffusor is composed of a composition sponge of fine porosity in a non-corrodible casing. It becomes saturated with water because of the capillary action of the sponge with the water.

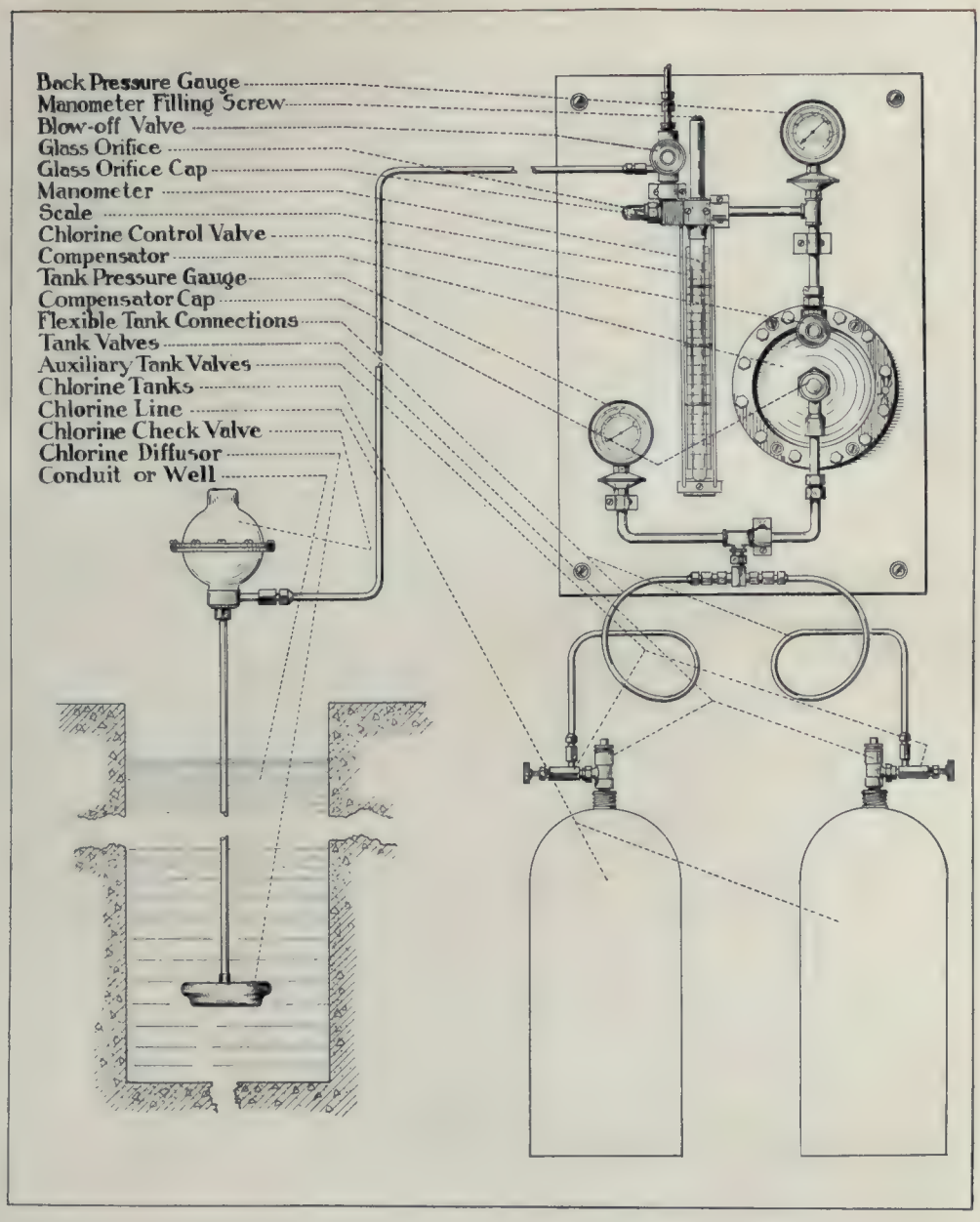
The gas is forced through the diffusor in minute bubbles which during passage become saturated with water. When they strike the water, they go immediately into solution, not only on account of their fineness but because they are fully saturated.

When this apparatus is used to apply chlorine to open bodies of water or sewage, such as reservoirs, gate chambers, conduits, pump wells and the like, it is known as type *MDA*.

The diffusor used in this instance is about four inches in diameter and must have a minimum submergence of four feet at all rates of flow.

When the chlorine is introduced in closed mains, it is known as type *MDAM*.

With the *MDAM* equipment, a special diffusor is used of either a disc or pencil type.



MANUAL CONTROL, DIRECT FEED CHLORINATOR, TYPE *MDA*

Twenty-five pounds per square inch pressure in the main, is the maximum for which type *MDAM* is recommended, unless a water supply under high pressure is available to operate an injector.

The apparatus illustrated is installed at Smith's Pond Pumping Station, Brooklyn, N. Y., having a capacity of 50,000,000 gallons daily.

Applicability of Type *MDA*

This apparatus is intended for the application of chlorine to open bodies of water or sewage.

It is manufactured in any capacity from one pound minimum to three hundred pounds maximum of chlorine per twenty-four hours. The most accurate range of the apparatus is from one to five. That is, the minimum flow should not be less than one fifth of the maximum for which the apparatus is constructed.

If the length of the chlorine line is in excess of twenty-five feet, it is recommended that half inch extra heavy galvanized iron piping be used to conduct the gas from the apparatus to the check valve, special flexible connections being furnished to run from the galvanized iron piping to the chlorinator, and to the check valve. The tubing running from the check valve to the diffusor is pure silver.

The chlorine diffusor must always have a minimum submergence of at least four feet. With this submergence, each diffusor will pass a maximum of forty pounds of chlorine per twenty-four hours. As many diffusors as required can be connected to a suitable header of silver tubing.

The check valve should be located well above the maximum water level, in a fairly accessible position, and protected by suitable housing.

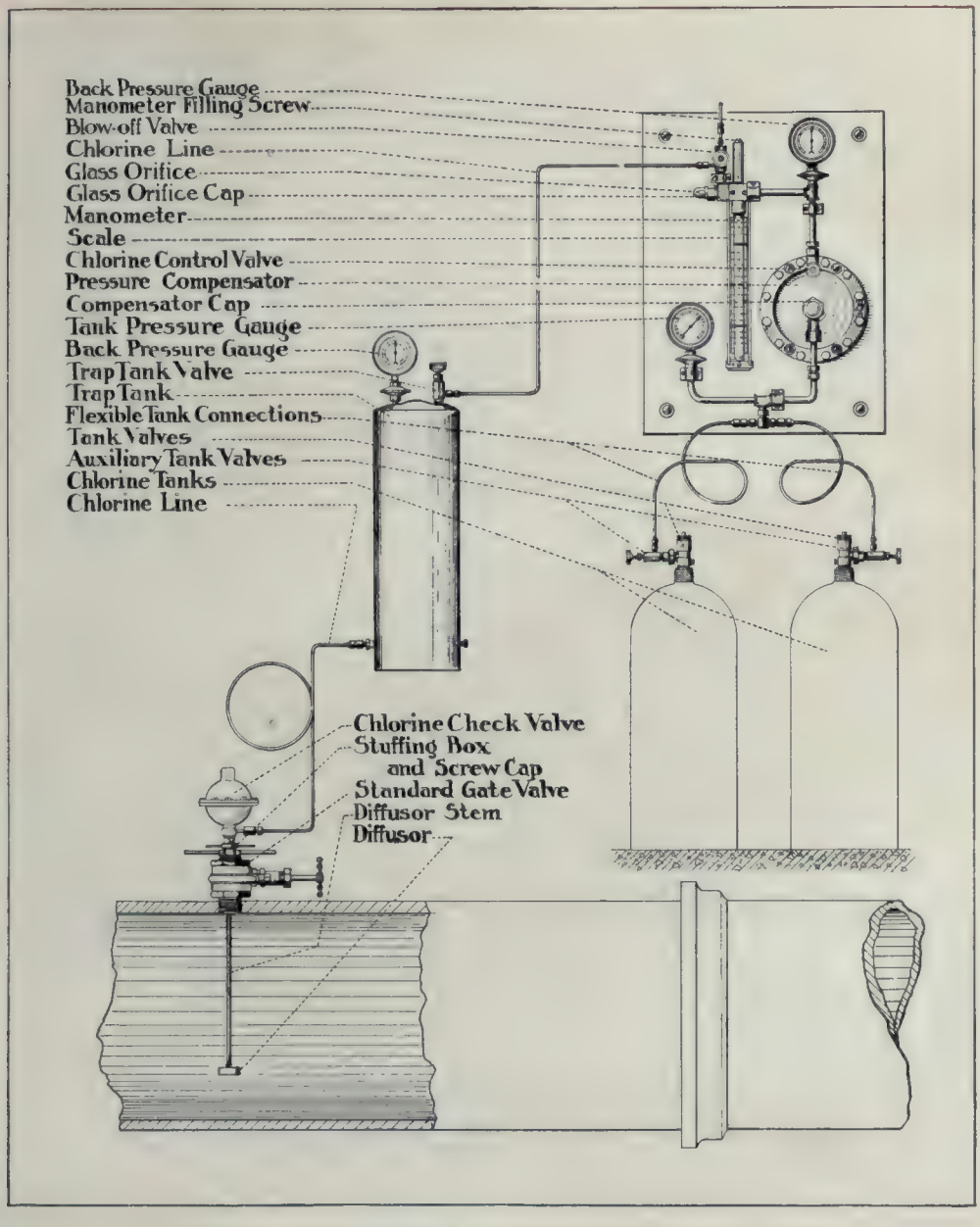
Applicability of Type *MDAM*

This apparatus is designed to apply chlorine in mains under pressure.

Ordinarily, the maximum pressure against which the chlorine can be applied successfully with this type is twenty-five pounds per square inch.

The most accurate range of the apparatus is from one to five. That is, the minimum flow should not be less than one-fifth of the maximum for which the apparatus is constructed.

Either pencil or disk diffusors are furnished depending upon local conditions.



MANUAL CONTROL, DIRECT FEED CHLORINATOR, TYPE *MDAM*

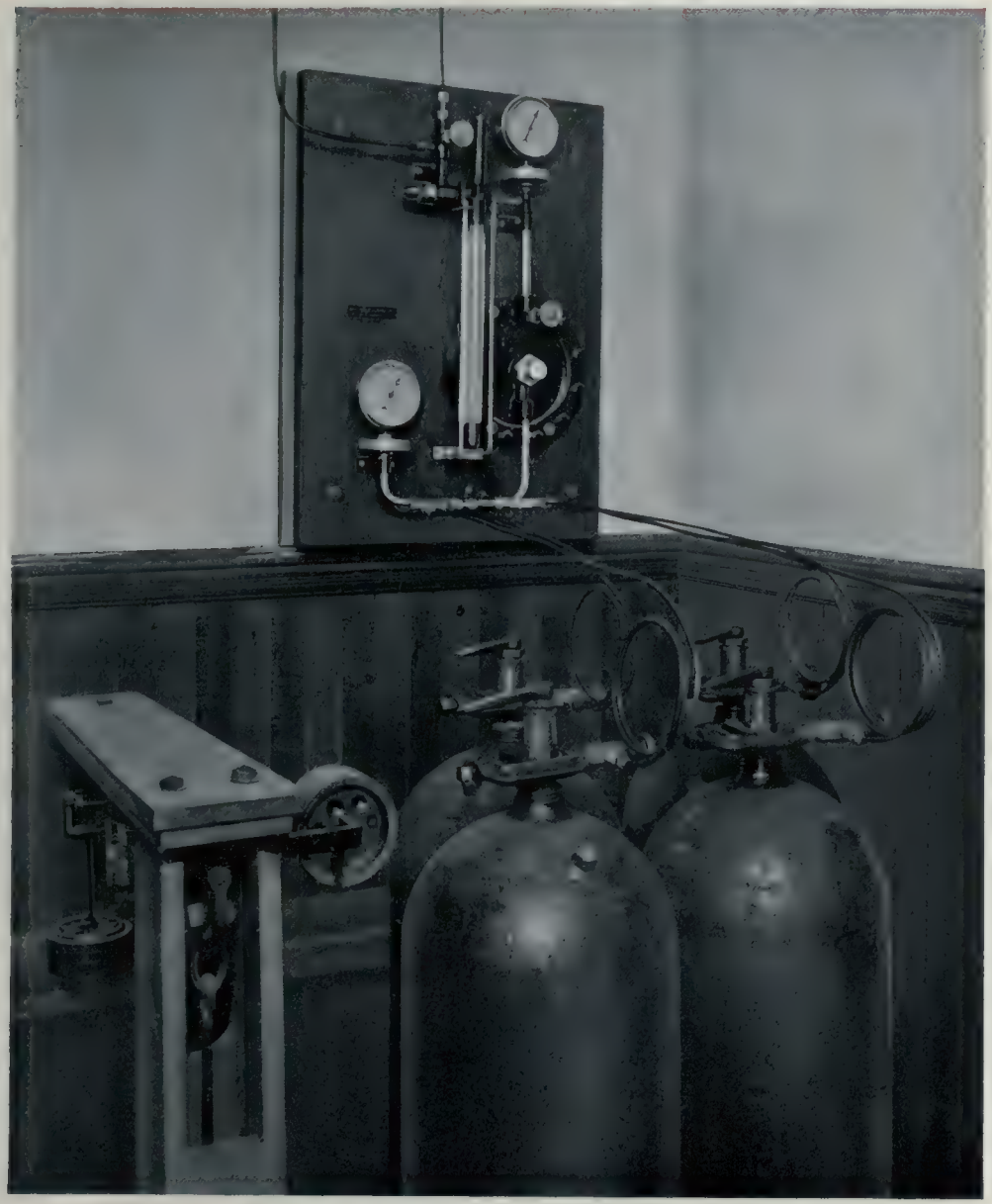
The pencil diffusor requires a one inch tapping in the main and can be inserted through a special corporation cock.

The disk diffusor requires a two inch tapping and special two inch gate valve and fittings for mains twenty inches or less in diameter. With larger mains two and one-half inch tappings and fittings are required and a twin disk diffusor may be used.

Stuffing boxes are provided in all cases permitting the diffusors to be inserted and removed while the main is under pressure.

Reinforcing nipples to support the diffusor stem are furnished where necessary.

The trap tank serves as a reservoir to prevent flooding the chlorinator with water in case of leakage through the check valve due to improper operation. The trap tank is not required when the distance from the control panel to the point of application is in excess of twenty-five feet, as in such cases the galvanized iron pipe which is substituted for the trap tank serves the same purpose. It also provides a reserve supply of chlorine to give continuous feed of chlorine during short periods of shut down to adjust the control apparatus.



TYPE *MDA* TREATING THE WATER SUPPLY OF BROOKLYN, N. Y.

Semi-Automatic Control Chlorinators

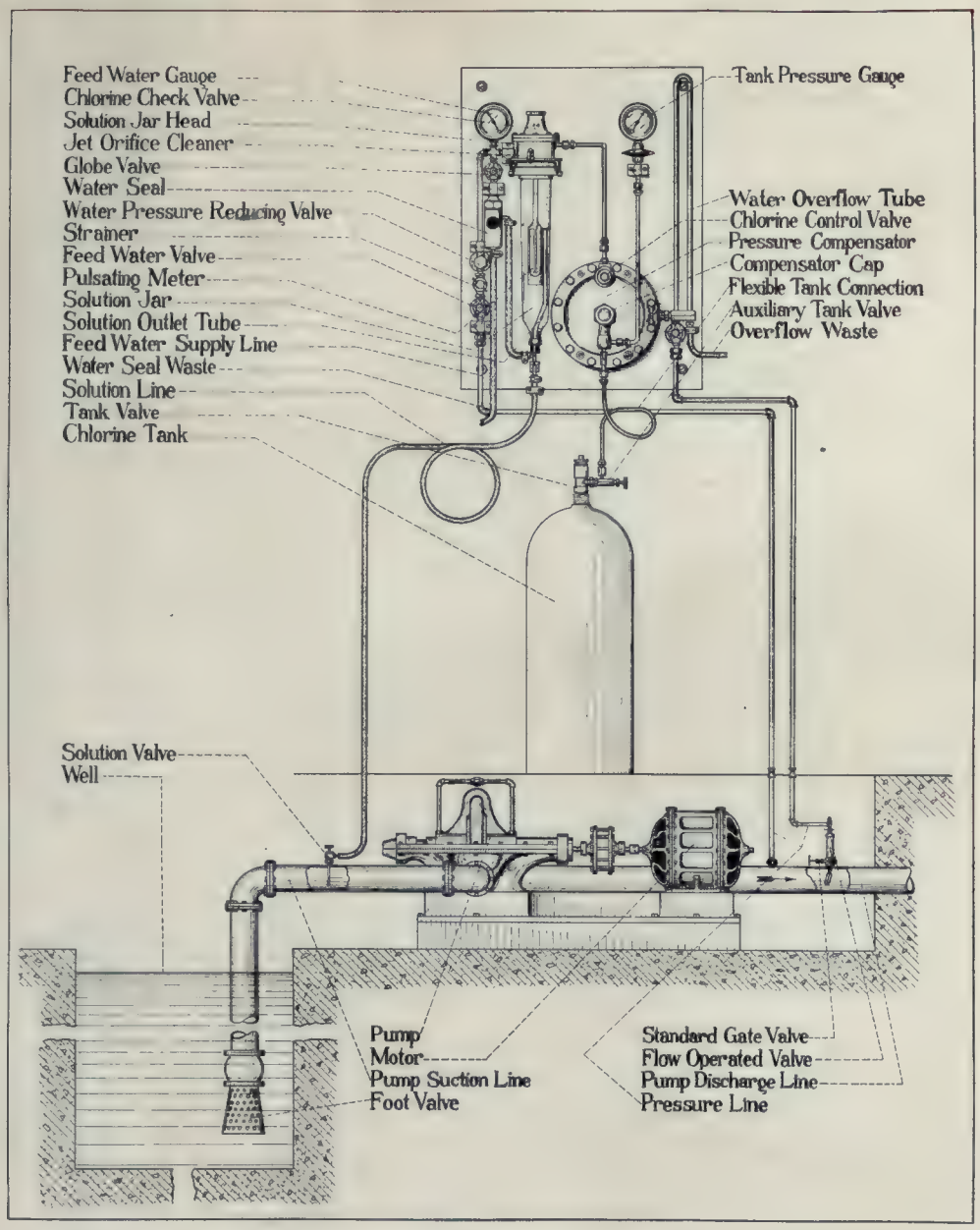
TYPES *SASA*, *SASAM*, *SASB*, *SASBM*, AND *SADA* AND *SADAM* (WITH INJECTOR)

USED in conjunction with automatic pumping units, where there is a constant flow of water or sewage when pumping. These types of semi-automatic apparatus are typically applicable at automatic water and sewage pumping stations where the pumps are electrically operated by floats, contact pressure gages, or other devices.

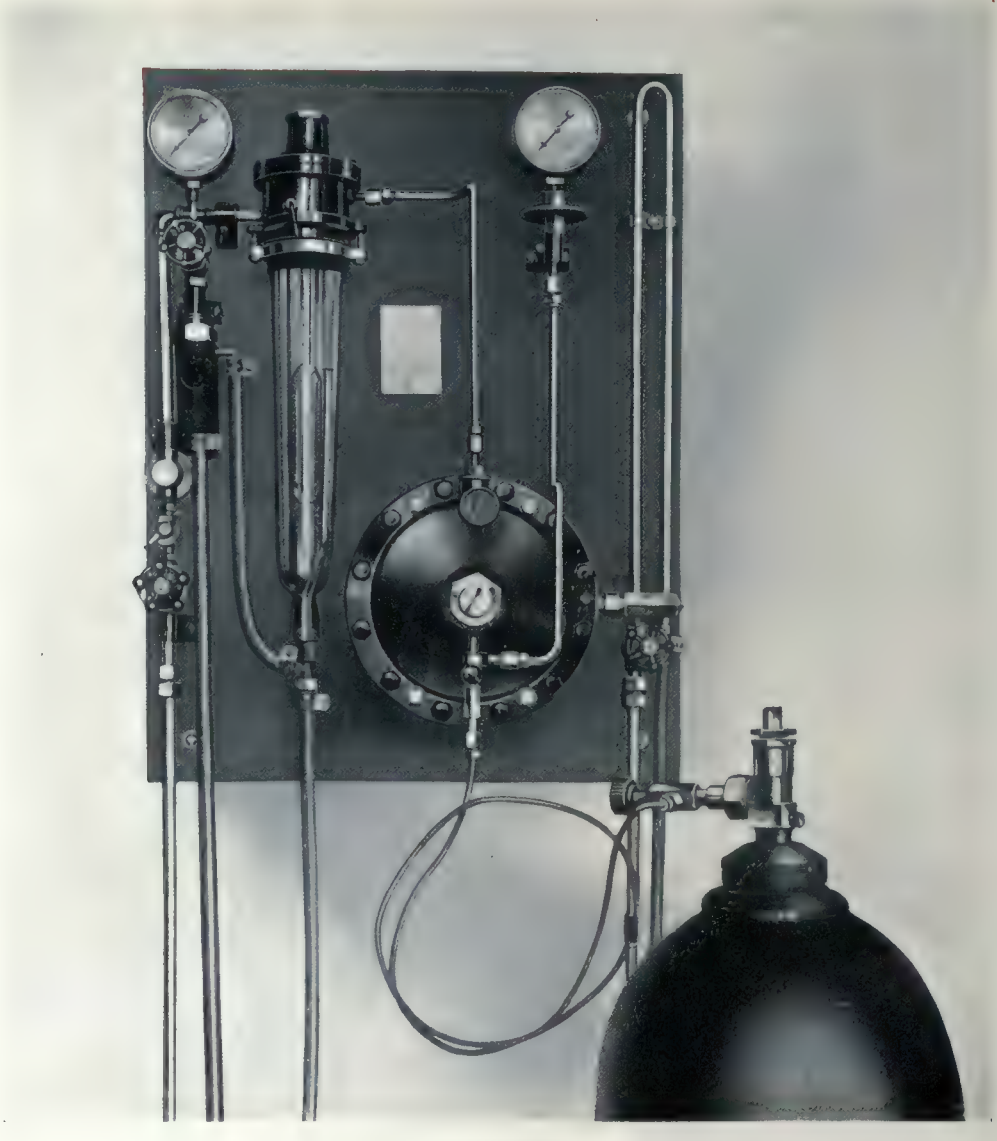
Any type of manually controlled chlorinator can be adapted for automatically starting the flow of chlorine at a predetermined rate when pumping begins and automatically stopping the chlorine flow when pumping ceases.

It is to be noted, however, that with any semi-automatic type of equipment the minimum allowable flow of chlorine is one pound per twenty-four hours.

Automatic starting and stopping may be obtained by the use of a vane mechanism, venturi tube, or float device. The drawing on page 33 indicates a manually controlled chlorinator solution feed type *A* adapted for semi-automatic control by a vane mechanism. Other types of manually controlled apparatus are similarly applicable.



SEMI-AUTOMATIC, SOLUTION FEED CHLORINATOR, TYPE *SASAM*, VANE OPERATED



TYPE *SASAM*

Automatic Apparatus

AUTOMATIC control of 'W & T' equipment is limited as below:

Venturi Operated. The rate of flow of water through the venturi tube must afford a minimum differential head of not less than four inches to have the apparatus operate within the 90% accuracy guarantee. The venturi tube must always flow full of water. The maximum pressure in the venturi tube used to obtain automatic control must not exceed one hundred and twenty-five pounds per square inch.

Float Operated. (a) Weir Type. Weirs used for float operated automatic control should give, at maximum flow, a head of four to six inches to permit using standard equipment. Special floats may be designed for heads up to twenty-four inches. (b) Submerged Orifice Type. Orifices used for automatic control must always be submerged and be designed to give a differential head of from one half inch to eight inches.

Pitot Operated. To secure automatic control from a pitot tube the minimum velocity in the water main, which must always flow full, should be not less than one half foot per second.

Automatic Control, Solution Feed Chlorinator

TYPES *ASAV, ASAF, ASAP, ASAMV, ASAMF, ASAMP*

SUCH types of apparatus are used for the automatic control and application of chlorine solution at installations requiring not more than twelve pounds of chlorine per twenty-four hours.

Automatic control may be obtained from a venturi tube (Type *ASAV*), or float operated by the head over a weir or submerged orifice (Type *ASAF*), or from a pitot tube (Type *ASAP*).

The chlorine gas from the containers passes through the automatic compensator, which varies the rate of flow of chlorine in accordance with the rate of flow of water. From the compensator the chlorine passes through the check valve and the solution jar head, being measured by a pulsating meter, into the chlorine solution jar where it is mixed with water. The water is introduced from the feed water supply line through the jet orifice in the solution jar head. The chlorine solution formed in the solution jar passes through the solution outlet tube and through the solution line to the desired point of application.

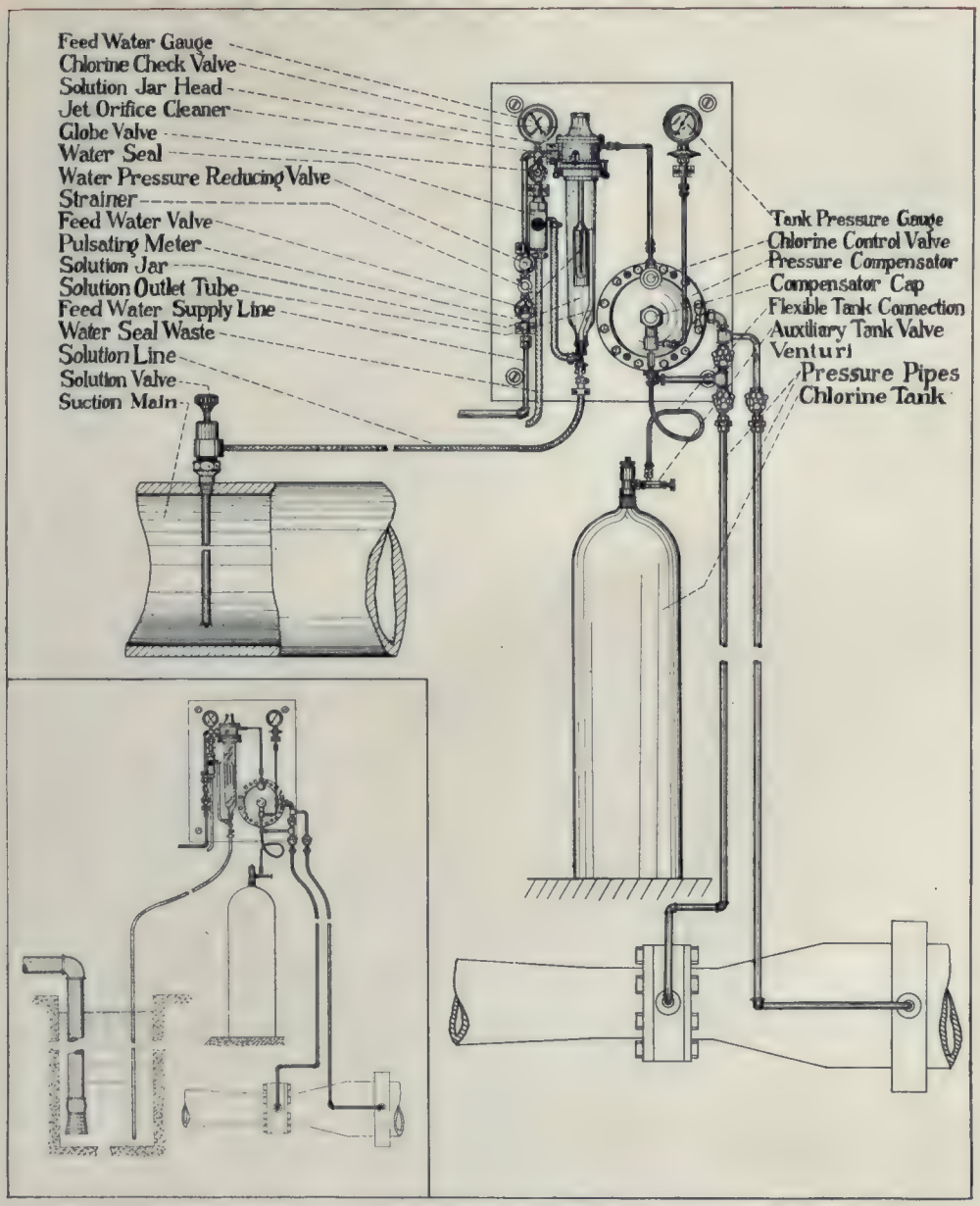
When the application is made in a pump suction main, a water seal is furnished to prevent air being drawn into the pump,—make up water being furnished for the water seal. When the suction varies, a solution receiver is furnished to stabilize the flow.

The chlorine solution is introduced in suction lines, or other pipe lines not under pressure, through a chlorine solution valve of silver and vulcanite and when this valve is used the symbol '*M*' (Main) appears in the type designation.

A chlorine solution valve is not required when application is made in an open body of water.

APPLICABILITY OF TYPES *ASAV, ASAF, ASAP, ASAMV, ASAMF, ASAMP*

This apparatus is applicable to any installation requiring not more than twelve pounds of chlorine per twenty-four hours, and not less than one pound



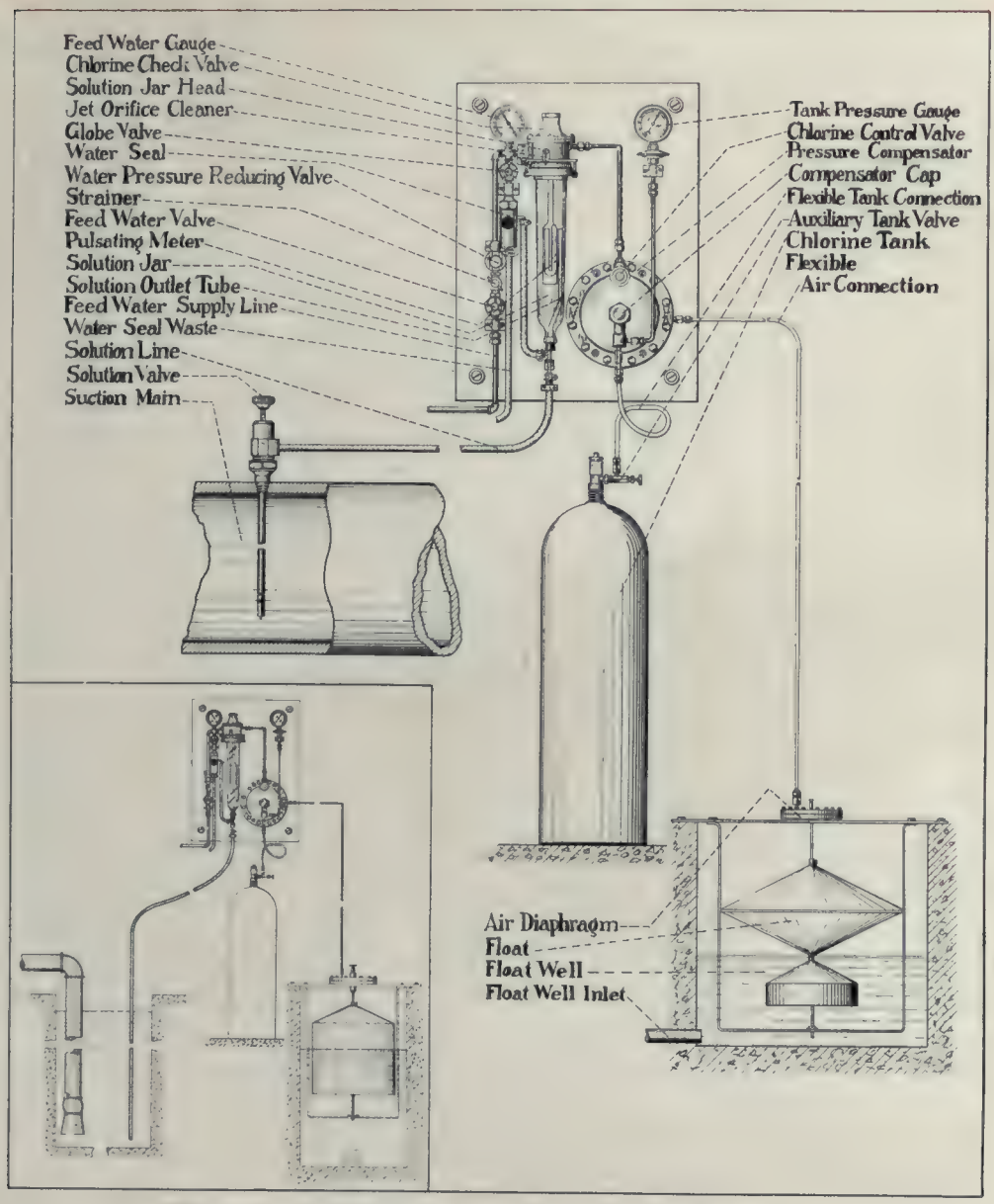
TYPE *ISAV* TYPE *ASAMV*

AUTOMATIC CONTROL, SOLUTION FEED, VENTURI OPERATED CHLORINATOR

of chlorine per twenty-four hours, where the chlorine can be introduced in a pump well, pump suction main, gate chamber, or some other portion of the system where there is no positive pressure. It can be combined with our chlorine solution injector or chlorine solution pump for application against pressure.

There is required a water supply of approximately twenty gallons per hour with a pressure not less than fifteen pounds per square inch to operate this equipment. Higher pressures are regulated by the water pressure reducing valve on the feed water supply line.

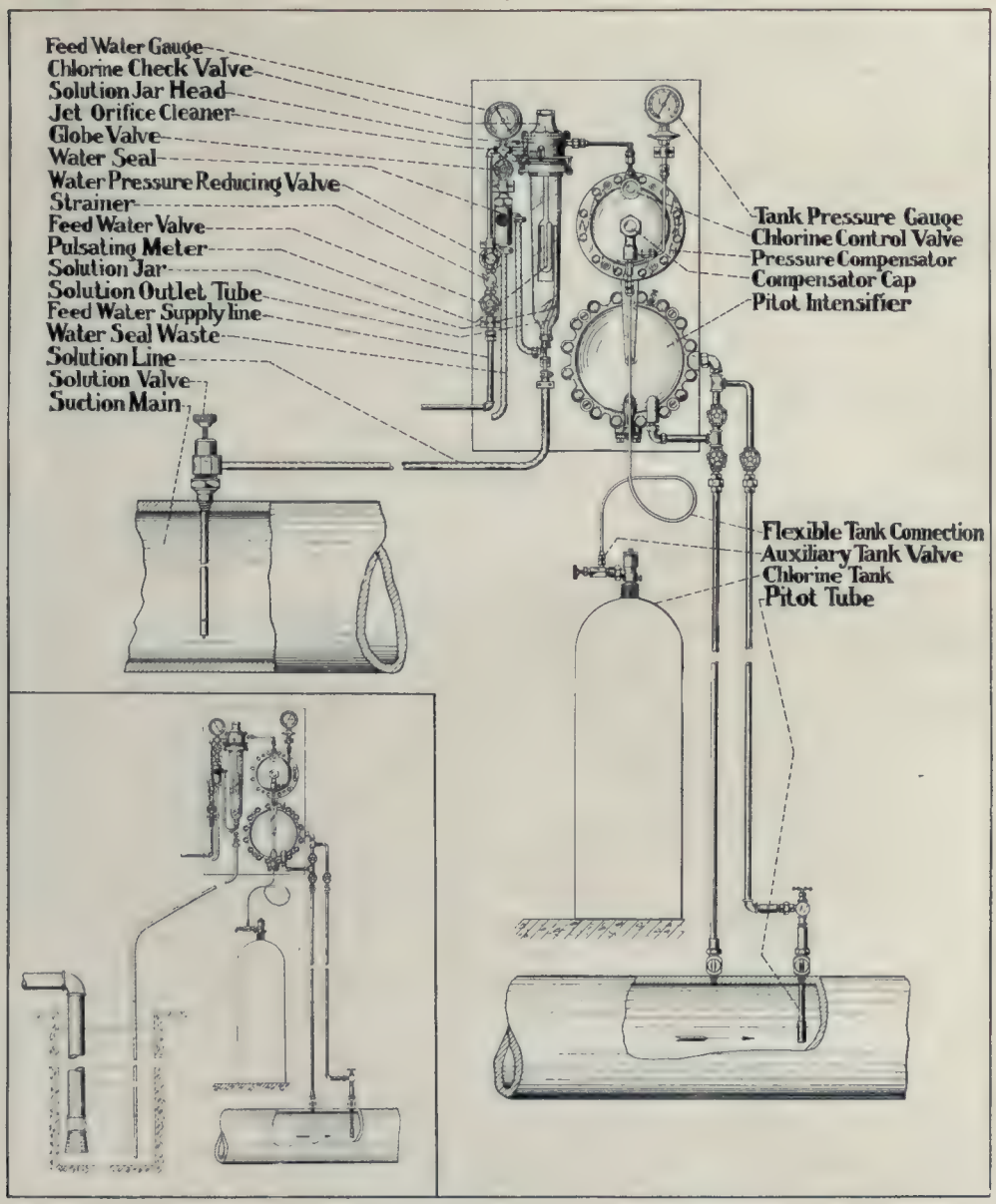
It is desired frequently to install this type of apparatus in pumping stations where there are two or more pump suction lines. By using a split feed device of silver and vulcanite and a solution valve for each suction main, the chlorine solution can be divided and applied as desired. This increases the flexibility of the installation.



TYPE *ASAF* TYPE *ASAME*

AUTOMATIC CONTROL, SOLUTION FEED, FLOAT OPERATED CHLORINATOR

CHLORINATOR HOUSE AT SEWAGE DISPOSAL WORKS INSTALLED FOR EMERGENCY FLEET CORPORATION AT HOG ISLAND SHIPYARD



TYPE *AS.AP* TYPE *ASAMP*

AUTOMATIC CONTROL, SOLUTION FEED, PITOT OPERATED CHLORINATOR

Automatic Control, Solution Feed Chlorinators

TYPES *ASBV, ASBF, ASBP, ASBMV, ASBMF, ASBMP*

THESE types of automatically operated solution feed apparatus have been developed for use where more than twelve pounds of chlorine per twenty-four hours are required. Automatic control may be obtained from venturi tube (type *ASBV*) or float operated by the head over a weir or submerged orifice (type *ASBF*) or from a pitot (type *ASBP*). The chlorine gas from the containers passes through the automatic compensator, which varies the flow of chlorine in accordance with the flow of water. From the compensator the chlorine passes through a visible glass orifice, measured by a manometer flow meter to the chlorine check valve. From the check valve, the chlorine passes into the solution jar. Water under pressure is introduced from the water supply line through a jet into the solution jar insuring complete absorption of the chlorine by the water.

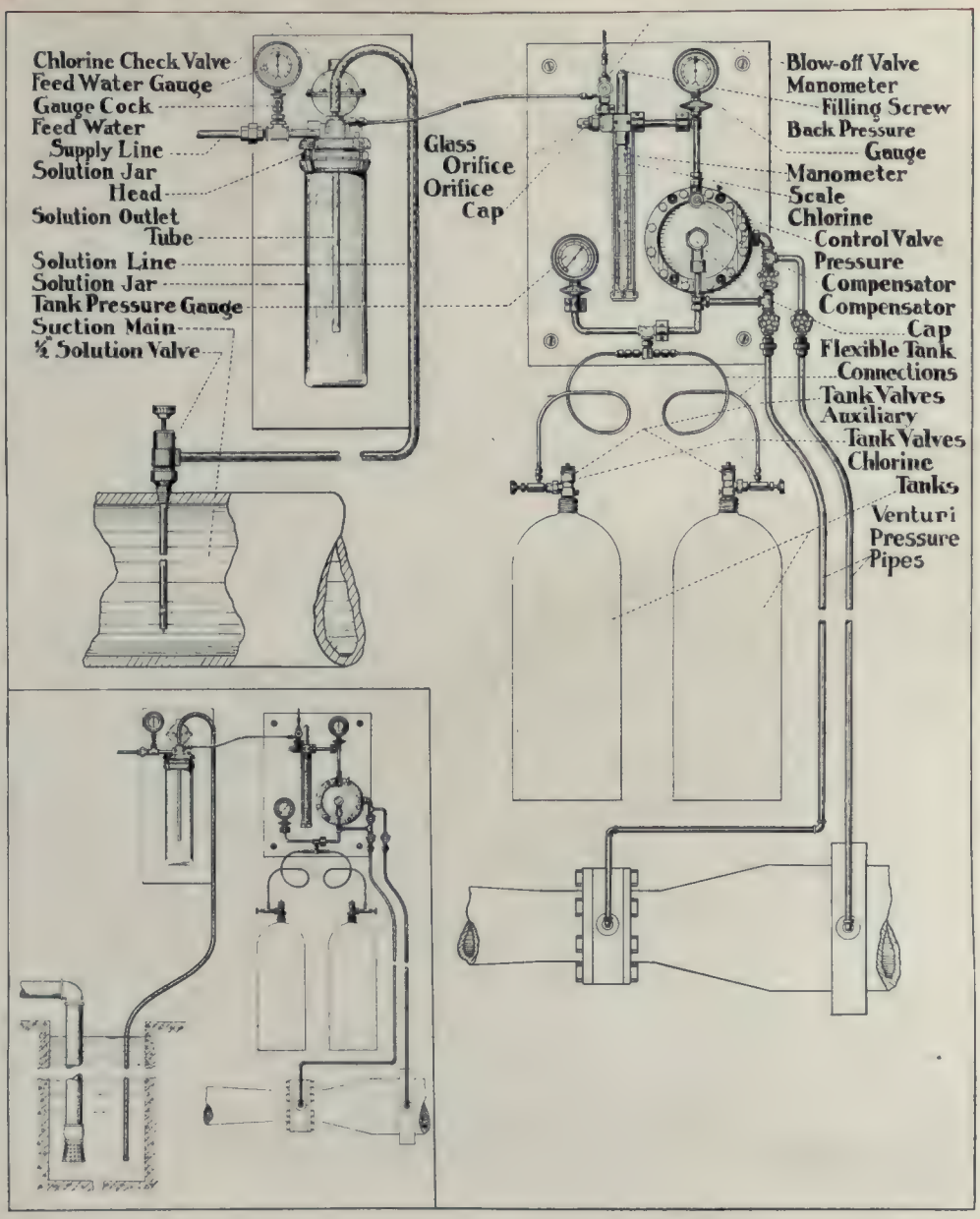
The chlorine check valve prevents moisture getting back into the control mechanism, and the solution jar, being of glass, facilitates inspection, making the solubility of the chlorine actually visible.

The chlorine measuring device and the absorption device are separate independent units. They may be located either near together or apart, as conditions of installation require.

For introducing the solution in suction or other pipe lines not under pressure, a chlorine solution valve of silver and vulcanite is used and the symbol *M* (Main) appears in the nomenclature.

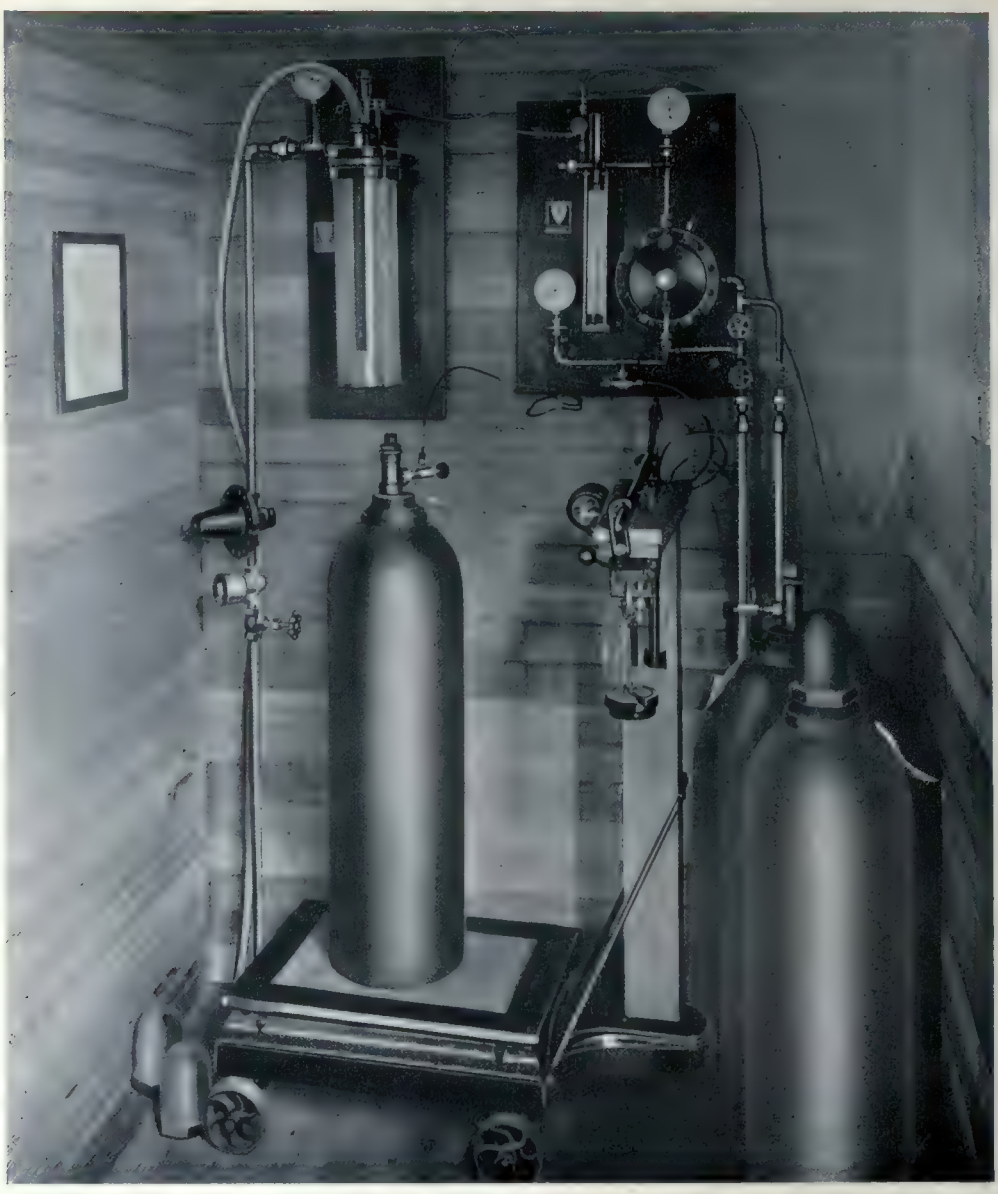
APPLICABILITY OF TYPES *ASBV, ASBF, ASBP, ASBMV, ASBMF, ASBMP*

This apparatus is applicable on all flows of chlorine up to two hundred pounds per twenty-four hours, where it is possible to apply chlorine solution at some point in the system where there is no positive pressure, application being usually made in pipe lines, pump wells, suction lines, gate chambers, etc. It can be combined with our chlorine solution injector for application against pressure.



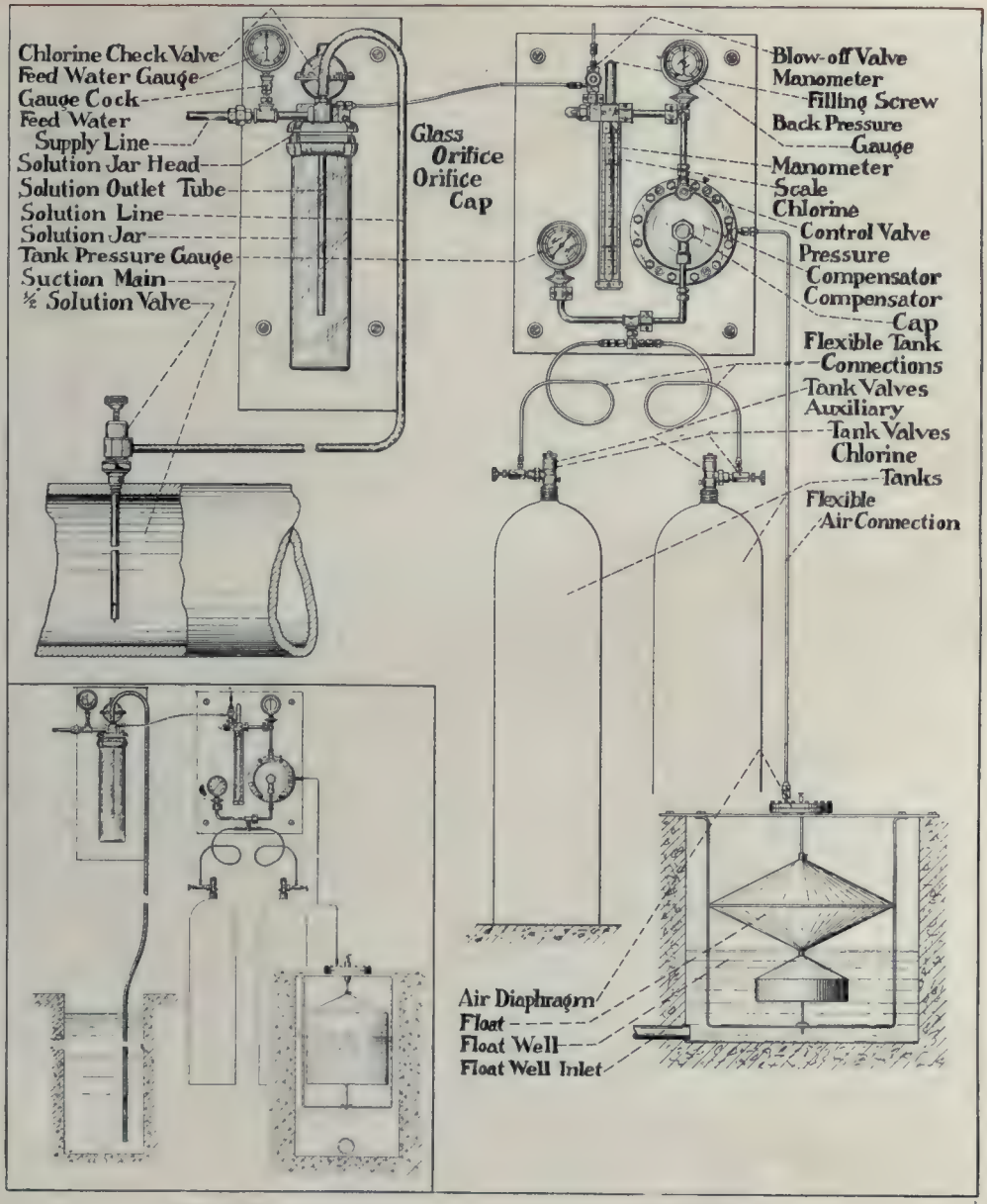
TYPE *ASBV* TYPE *ASRMV*

AUTOMATIC CONTROL, SOLUTION FEED, VENTURI OPERATED CHLORINATOR



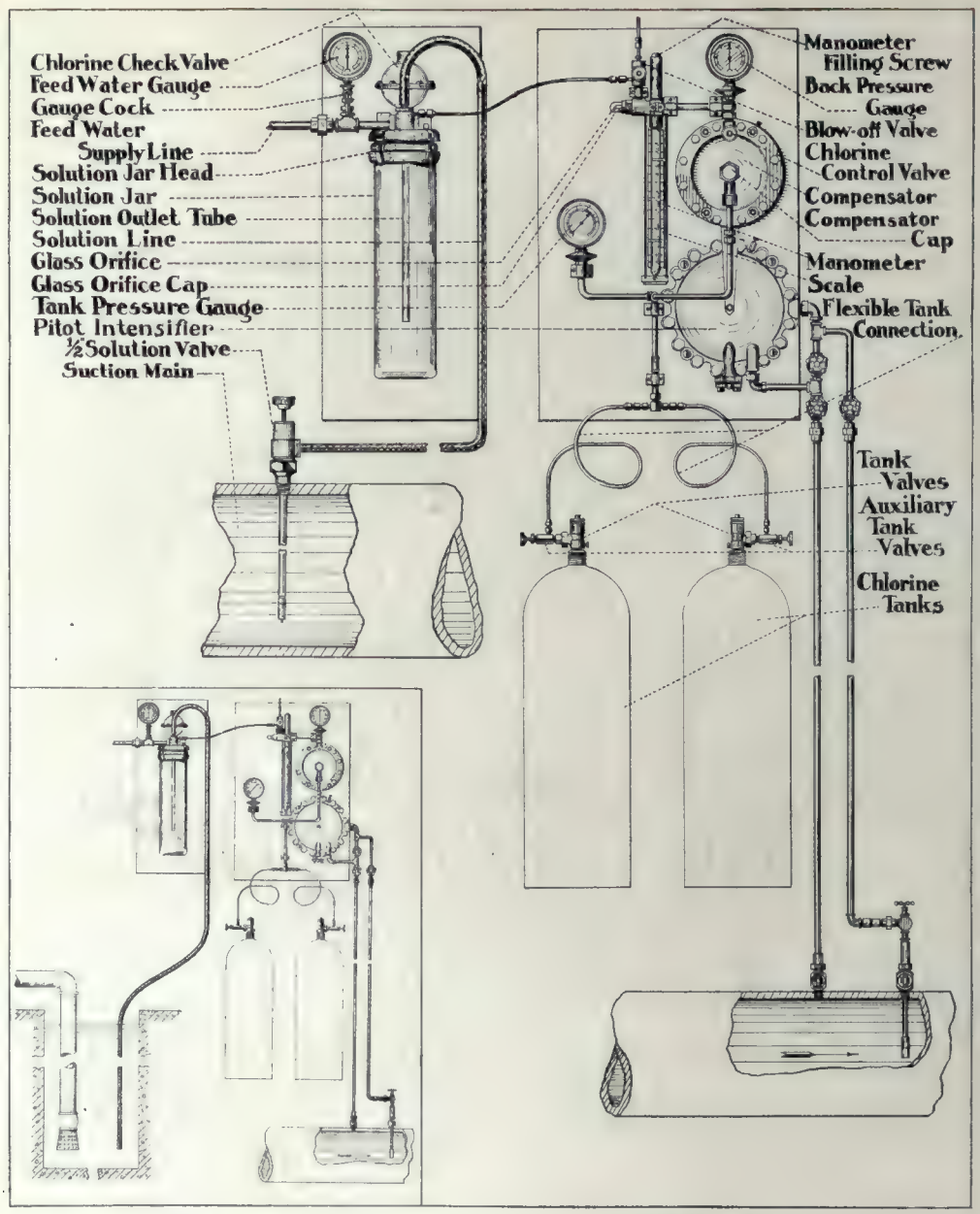
TYPE *ASBMV*

INSTALLED AT WATER PURIFICATION PLANT FOR THE EMERGENCY FLEET CORPORATION, HOG ISLAND SHIPYARD



TYPE *ASBF* TYPE *ASBMF*

AUTOMATIC CONTROL, SOLUTION FEED, FLOAT OPERATED CHLORINATOR



TYPE *ASBP* TYPE *ASBMP*

AUTOMATIC CONTROL, SOLUTION FEED, PITOT OPERATED CHLORINATOR

The most accurate range of the apparatus is from one to five. That is, the minimum flow should not be less than one-fifth of the maximum for which the apparatus is constructed.

This apparatus requires a water supply under a pressure of at least twenty pounds per square inch at a rate of fifty gallons for each pound of chlorine. A higher water pressure can be reduced by a regulating valve furnished with the apparatus, when required.

Automatic Control, Direct Feed Chlorinators

TYPES *ADAV, ADAF, ADAP, ADAMV, ADAMF, ADAMP*

EQUIPMENT of this type meets the requirements of automatic control and application of chlorine gas to water or sewage where there is not a water supply under pressure available to operate a solution feed equipment.

The chlorine from the containers passes through the automatic compensator, which varies the feed of chlorine in accordance with the variation of the rate of water flow. From the compensator, the chlorine gas passes through a visible glass orifice, measured by the manometer flow meter and thence to the chlorine line and check valve. From the chlorine check valve the gas passes through pure silver tubing to the point of application, where it is dissolved and distributed through the chlorine diffusor.

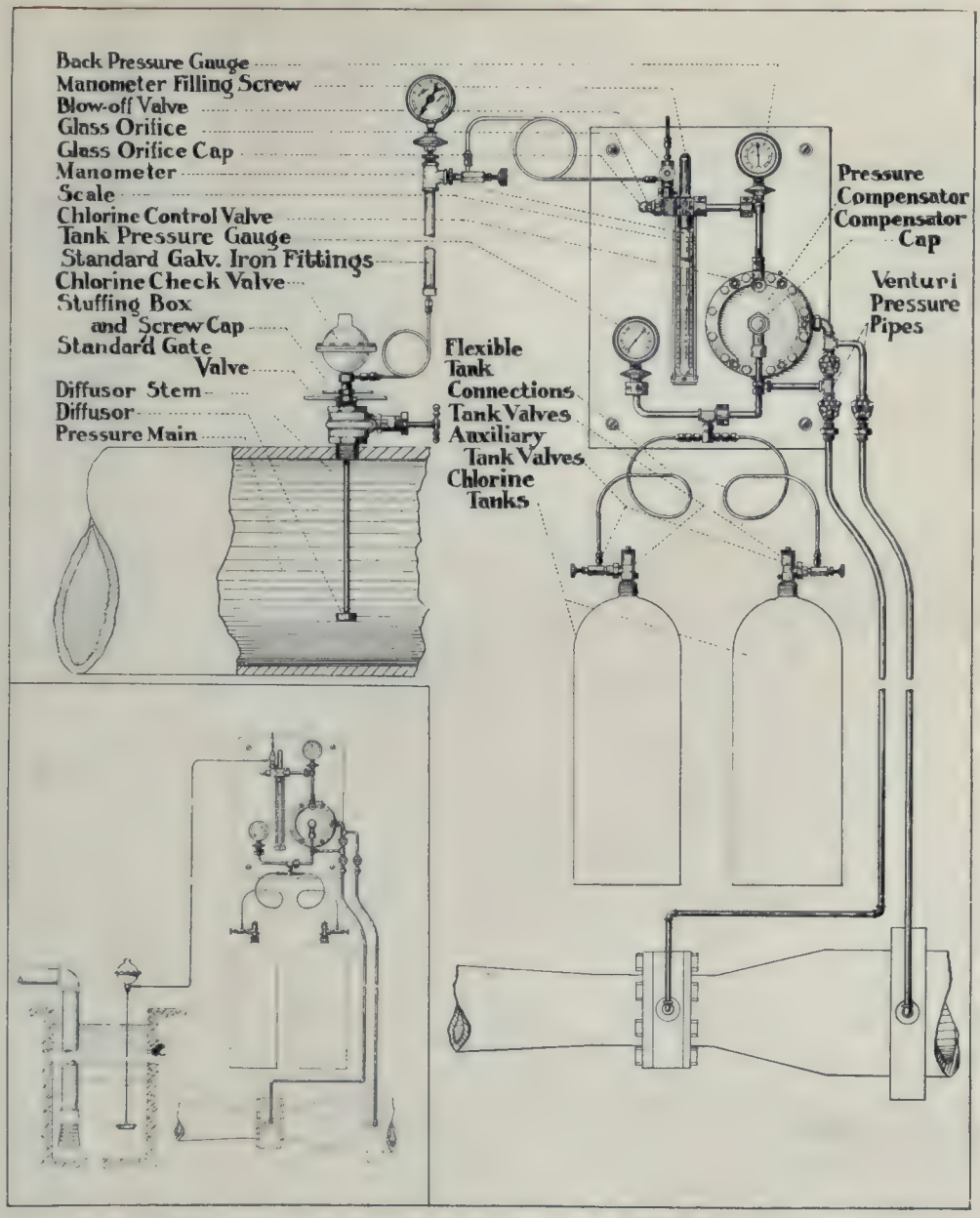
The chlorine line conducting the gas from the chlorinator to the check valve may be of copper or galvanized iron piping. Chlorine gas does not attack these metals when dry and moisture is kept out by the check valve. The dry gas can be piped any distance up to five hundred feet.

The diffusor is composed of composition sponge of fine porosity in a non-corrodible casing. It becomes saturated with water because of the capillary action of the sponge with the water.

The gas is forced through the diffusor in minute bubbles which during passage become saturated with water. When they strike the water, they pass immediately into solution, not only on account of their fineness but because they are fully saturated.

When the apparatus is used to apply chlorine to open bodies of water or sewage, such as reservoirs, gate chambers, conduits, pump wells and the like, the diffusor used is about four inches in diameter. It must have a minimum submergence of four feet at all rates of flow.

When application of the chlorine is made in closed mains, the symbol *M* (Main) appears in the type nomenclature and a special diffusor is used of either a disk or pencil type.



TYPE *ADAV* TYPE *ADAMV*

AUTOMATIC CONTROL, DIRECT FEED, VENTURI OPERATED CHLORINATOR

Twenty-five pounds per square inch pressure in the main is the maximum for which the latter types are recommended unless a water supply under high pressure is available to operate an injector.

Applicability of Types *ADAV, ADAF, ADAP, ADAMV, ADAMF, ADAMP*

These types of equipment are designed for the automatic application of chlorine gas to water or sewage where there is not a water supply under pressure available to operate a solution feed equipment.

For application in open chambers it is manufactured in any capacity from one pound minimum to three hundred pounds maximum of chlorine per twenty-four hours. The most accurate range of the apparatus is from one to five. That is, the minimum flow should not be less than one fifth of the maximum for which the apparatus is constructed.

If the length of the chlorine line is in excess of twenty-five feet, it is recommended that half inch extra heavy galvanized iron piping be used to conduct the gas from the apparatus to the check valve, special flexible connections being furnished to run from the galvanized iron piping to the chlorinator, and to the check valve.

The chlorine diffusor must always have a minimum submergence of at least four feet. With this submergence, each diffusor will pass a maximum of forty pounds of chlorine per twenty-four hours. As many diffusors as required can be connected to a suitable header of silver tubing.

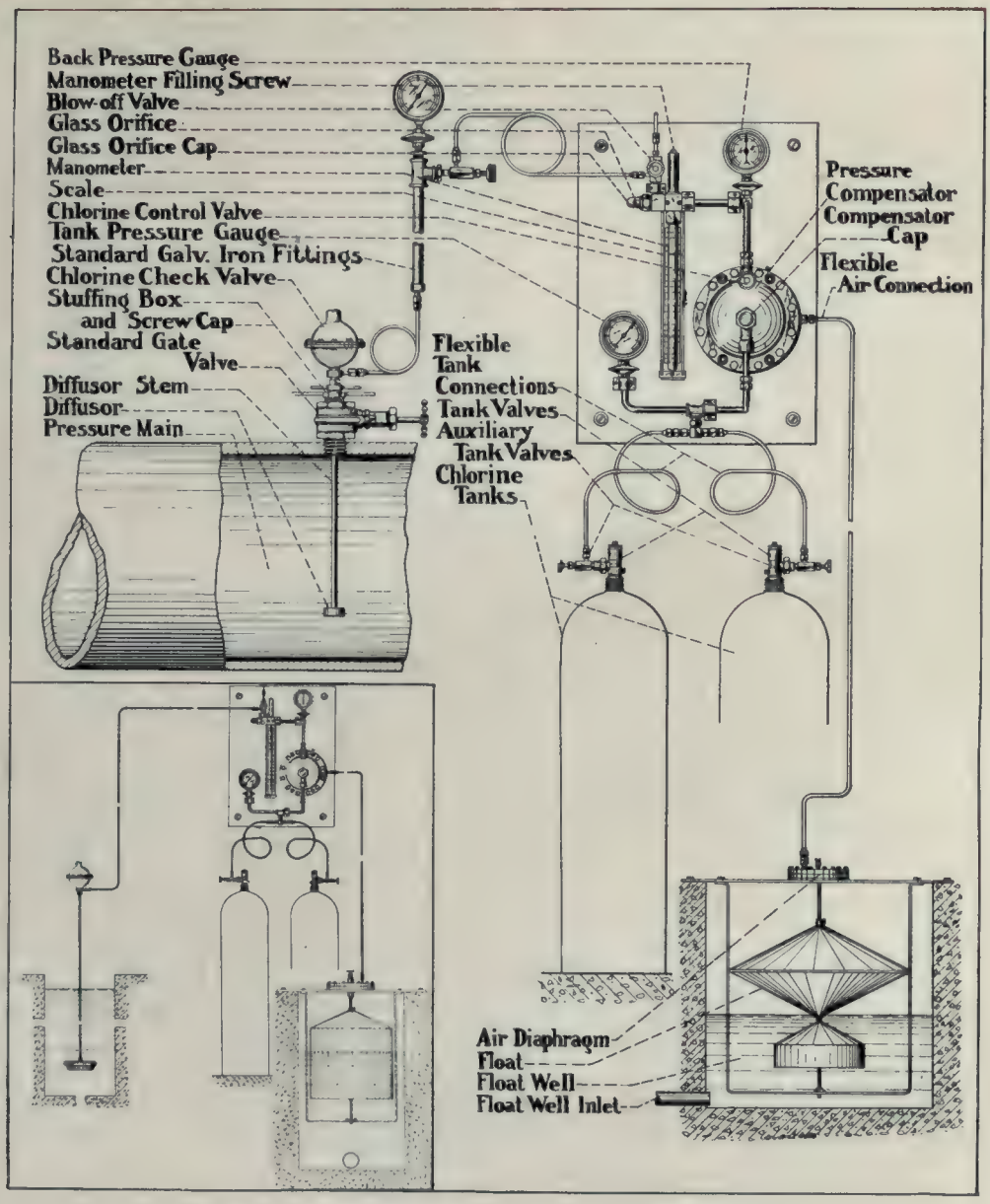
The check valve should be located well above the maximum water level, in a fairly accessible position, and be protected by suitable housing.

Applied in mains, either pencil or disc diffusors are furnished depending upon local conditions.

The pencil diffusor requires a one inch tapping in the main and can be inserted through a special corporation cock.

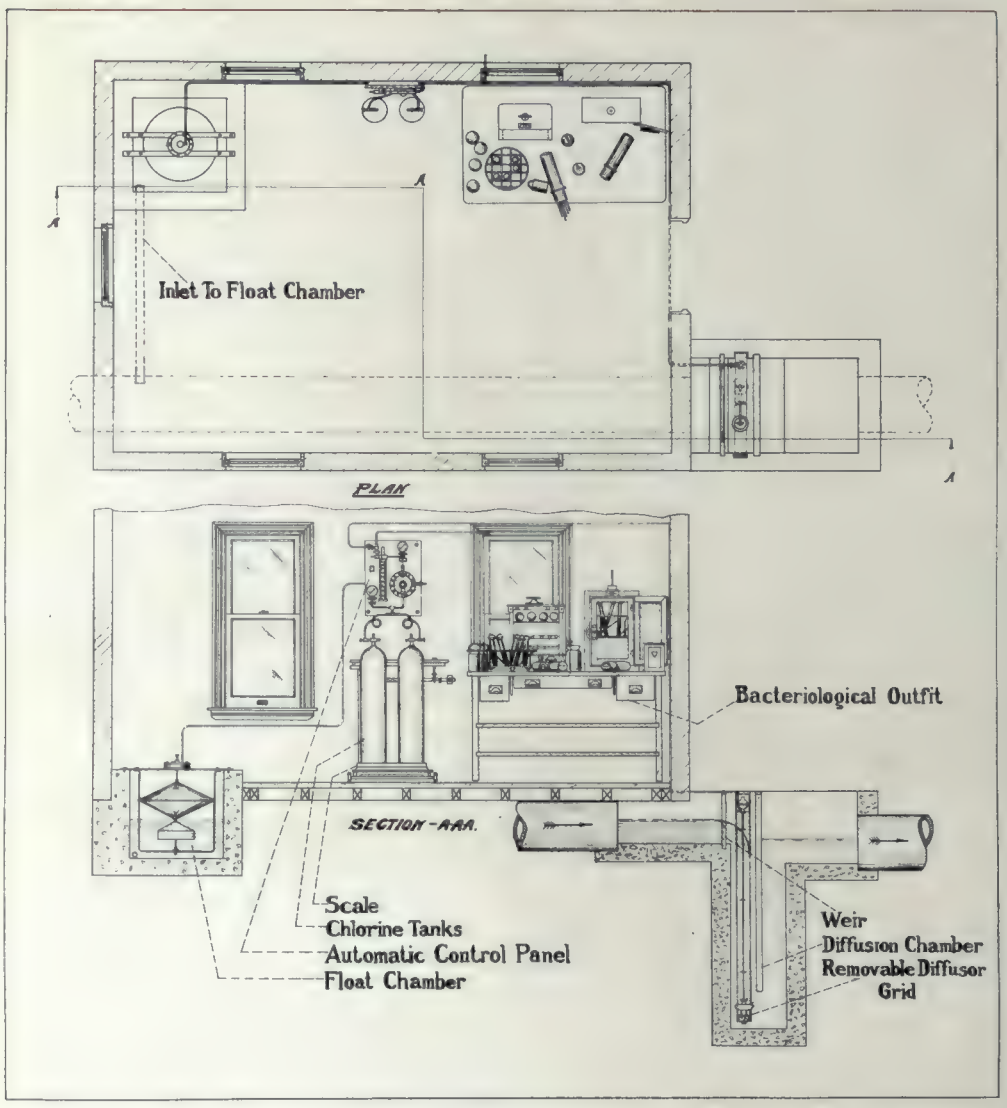
The disc diffusor requires a two inch tapping and special two inch gate valve and fittings for mains twenty inches or less in diameter. With larger mains two and one-half inch tappings and fittings are required and a twin diffusor may be used.

Stuffing boxes are provided in all cases permitting the diffusors to be inserted and removed while the main is under pressure.

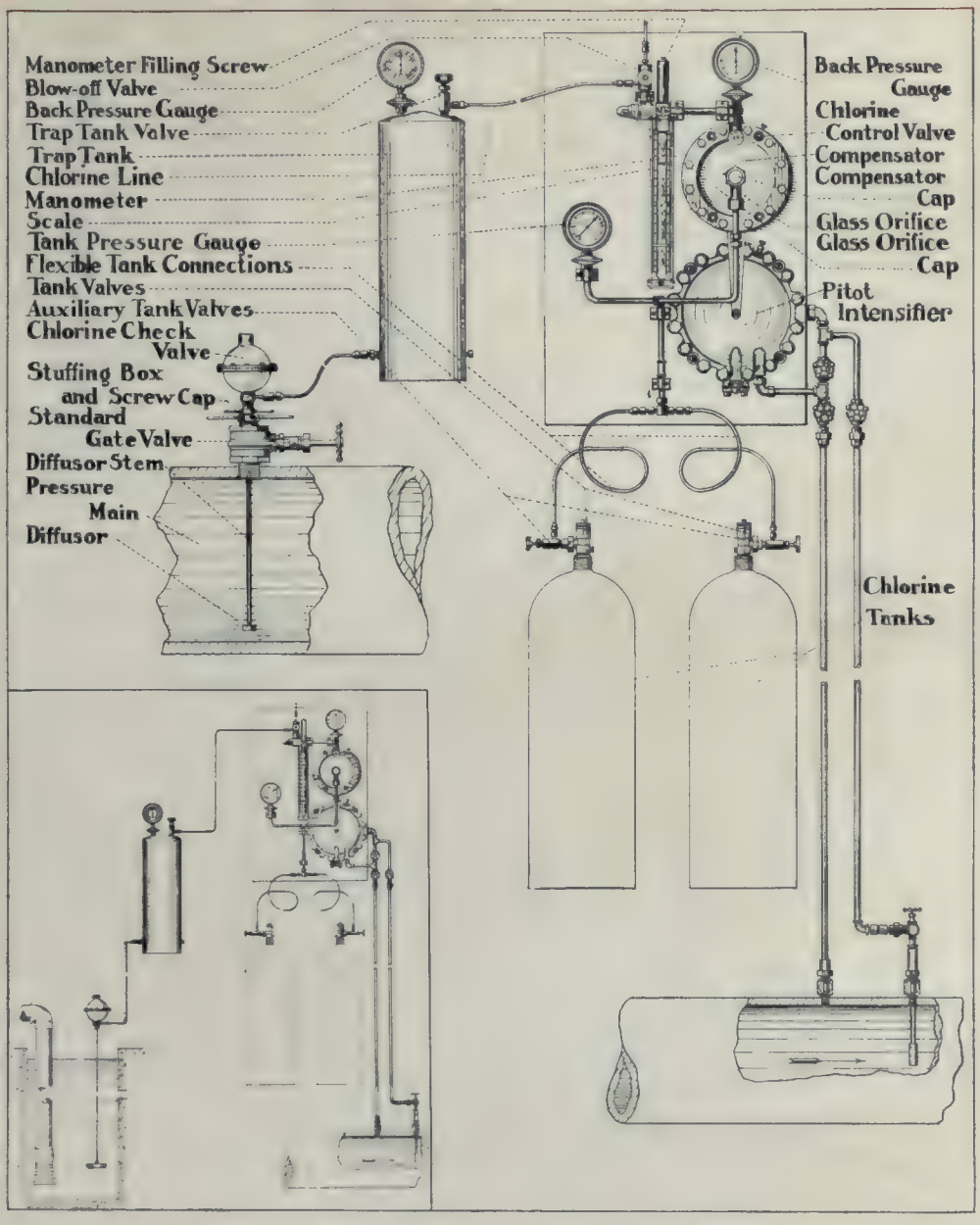


TYPE *ADAF* TYPE *ADAMF*

AUTOMATIC CONTROL, DIRECT FEED, FLOAT OPERATED CHLORINATOR



INSTALLATION OF AUTOMATIC CONTROL CHLORINATOR, TYPE *ADAF*, TREATING SEWAGE



TYPE *HPIP* TYPE *HPAIP*

AUTOMATIC CONTROL, DIRECT FEED, PITOT OPERATED CHLORINATOR

Ordinarily the maximum pressure against which the chlorine can be applied successfully with this type is twenty-five pounds per square inch.

Reinforcing nipples to support the diffusor stem are furnished where necessary.

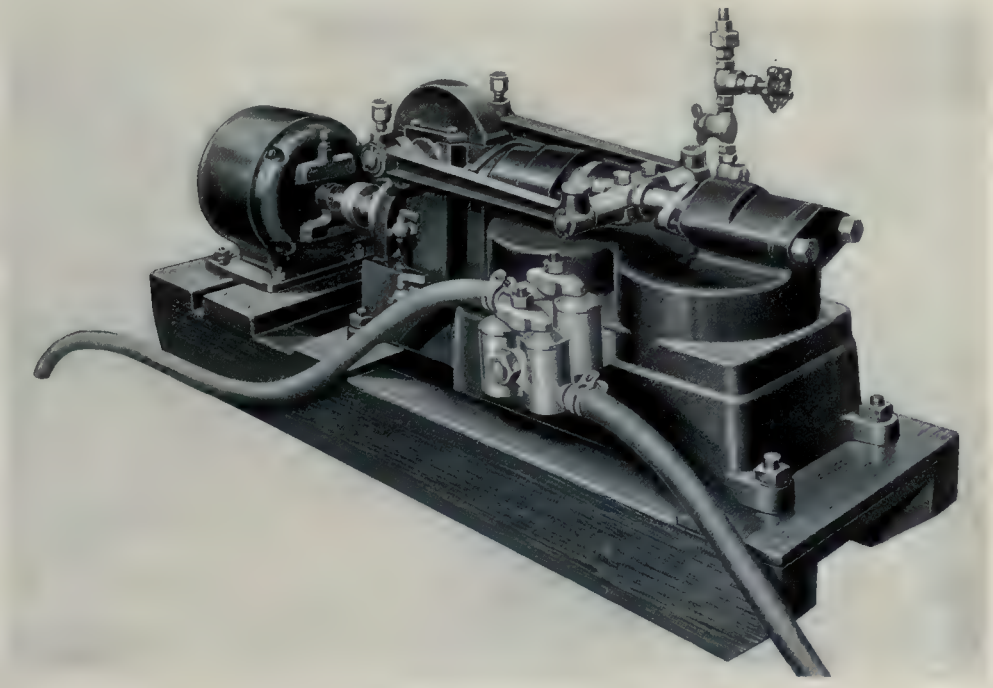
The trap tank serves as a reservoir to prevent flooding the chlorinator with water in case of leakage through the check valve due to improper operation. The trap tank is not required when the distance from the control panel to the point of application is in excess of twenty-five feet as in such cases the galvanized iron pipe which is substituted for the trap tank serves the same purpose. It also provides a reserve supply of chlorine to give continuous feed of chlorine during short periods of shut down to adjust the control apparatus.

Solution Pumps

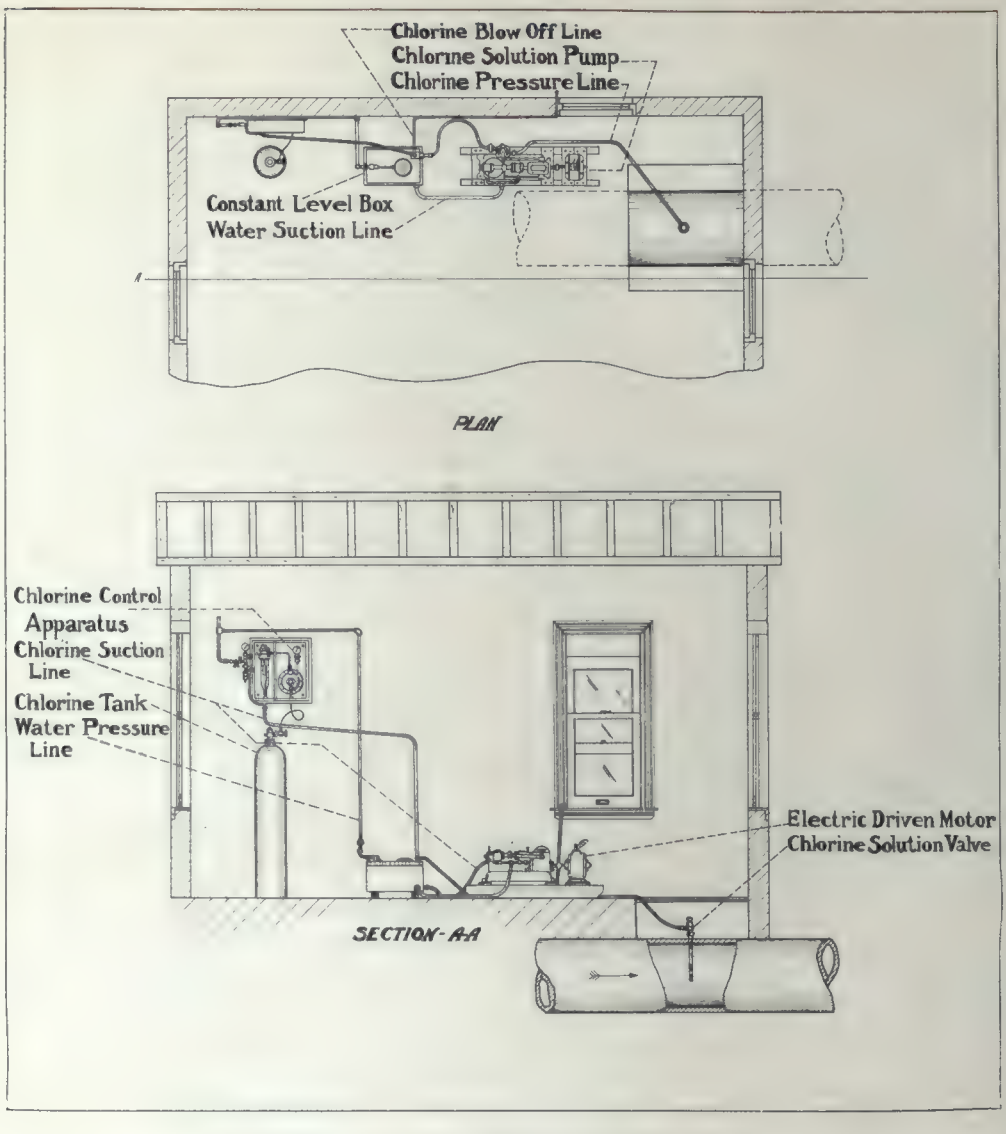
CHLORINE may be introduced against high pressure by the 'W & T' Solution Pump. This affords a wider range of applicability than given by the injectors or the direct feed chlorinators.

The pump is designed so that the corrosive chlorine solution does not come in contact with the metal working parts. A special non-corrodible valve mechanism is arranged so as to be easily removed for examination. It can be operated by electric motor or water motor as desired.

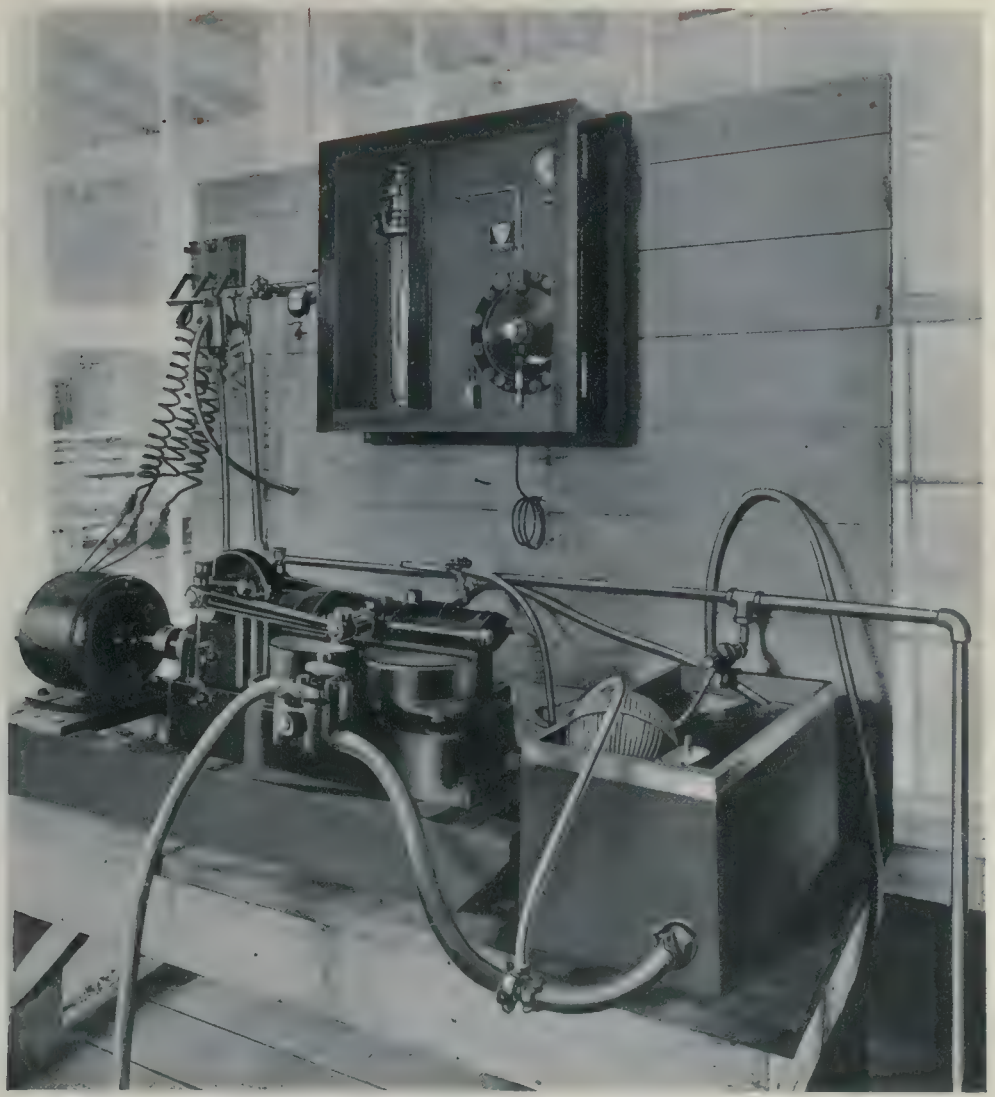
The 'W & T' Solution Pump is absolutely non-corrodible and carries the same guarantee of performance that characterizes all 'W & T' equipment. It, therefore, renders the process of chlorination applicable to any problems of water or sewage treatment which may be encountered where the chlorine must be introduced against pressure.



'W & T' CHLORINE SOLUTION PUMP



TYPE *MSA* WITH CHLORINE SOLUTION PUMP



INSTALLATION TYPE *MSAM* WITH 'W & T' SOLUTION PUMP AT WATER WORKS OF U. S. NAVAL OPERATING BASE, HAMPTON ROADS, VA.

IN the following pages a few of the many installations of 'W & T' apparatus for water and sewage chlorination are indicated. Taken from over two thousand installations those cited will demonstrate the prestige of our apparatus.

Over one hundred installations at Government Camps and Military Establishments in the United States.

Several hundred units in use by the American, British, Belgian, and Italian Armies in the field.

NEW YORK CITY, N. Y. Fifteen installations of manually controlled apparatus with capacity for treating nearly 1,000,000,000 gallons of water each day.

PHILADELPHIA, PA. Installed at Torresdale Water Filtration Plant.

CHICAGO, ILL. Equipment installed at Twenty-second Street Pumping Station.

BALTIMORE, MD. Equipment installed at Montebello Filters.

ALBANY, N. Y. Apparatus installed at Municipal Filtration Plant.

RICHMOND, VA. Automatically operated apparatus installed at water works.

DETROIT, MICH. Manually controlled apparatus installed at City Water Works.

DETROIT, MICH. Manually controlled apparatus installed at Belle Isle Park, treating sewage.

HARTFORD, CONN. Various units of equipment, manual and automatic, installed by Board of Water Commissioners.

NEW HAVEN, CONN. Seven units of equipment, manual and automatic, installed on water supply system.

STAMFORD, CONN. Three units of equipment, manual and automatic, installed on water supply system.

ATLANTA, GA. Municipal Water Works.

AUGUSTA, GA. Two units of manually controlled equipment installed at Municipal Water Works.

SPRINGFIELD, ILL. Municipal Water Works.

QUINCY, ILL. Municipal Water Works.

INDIANAPOLIS, IND. Two units manually controlled equipment installed at water works.

NEW ALBANY, IND. Apparatus installed at Municipal Water Works.

DES MOINES, IOWA. Automatic apparatus installed at water works.

DAVENPORT, IOWA. Manual control apparatus installed at water works.

HAMMOND, IND. Two units manually controlled equipment installed at water works.

LOUISVILLE, KY. Two units manually controlled equipment installed at water works.

COVINGTON, KY. Two units equipment, manual and automatic, installed at water works.

LEAVENWORTH, KAN. Manually controlled equipment installed at water works.

KENNEBUNK, ME. Manually controlled equipment installed at water works.

BUTTE, MONT. Two units manually controlled equipment installed at water works.

TRENTON, N. J. Two units manually controlled apparatus installed at Municipal Filtration Plant.

JERSEY CITY, N. J. Five units manually controlled apparatus installed on water supply.

NEW BRUNSWICK, N. J. Automatic and manually controlled equipment installed at pumping station and at Municipal Filtration Plant.

HANNIBAL, MO. Manually controlled equipment installed at water works.

SHEFFIELD, ALA. Equipment installed at water works and sewage plants.

BESSEMER, ALA. Manually controlled equipment installed at Municipal Water Works.

OAKLAND, CAL. Two units manually controlled equipment installed at water works.

BIRMINGHAM, ALA. Two units automatically operated apparatus installed at water plant.

BOULDER, COLO. Municipal Water Supply.

GREENWICH, CONN. Automatic apparatus treating municipal sewage.

STOCKTON, CAL. Manually controlled apparatus treating sewage.

MIAMI, FLA. Manually controlled equipment at water works.

SHOSHONE, IDAHO. Manually controlled apparatus at water works.

SAVANNAH, GA. Municipal Water Works.

ATLANTA, GA. Automatically operated apparatus treating sewage at Camp Gordon.

CALWA, CAL. Automatic apparatus treating sewage from Atchison, Topeka, and Santa Fe shops.

VALPARAISO, IND. Manually controlled apparatus at water works.

GARY, IND. Manually controlled apparatus at water works.

IOWA CITY, IOWA. Manually controlled apparatus at water works.

GREAT LAKES, ILL. Three units, manual and automatic equipment treating sewage.

DAVENPORT, IOWA. Manually controlled apparatus at water works.

SHREVEPORT, LA. Manually controlled apparatus at water works.

SALEM, MASS. Municipal Water Works.

WAKEFIELD, MASS. Municipal Water Works.

MANSFIELD, MASS. Apparatus treating sewage.

FT. BENJAMIN HARRISON, IND. Three units treating sewage.

WILDWOOD, N. J. Automatic apparatus treating sewage.

ELIZABETH, N. J. Equipment installed on water supply.

MILLVILLE, N. J. Apparatus installed at sewage disposal works.

NEWARK, N. J. Two units equipment installed on Municipal Water Supply.

ORANGE, N. J. Municipal Water Works.

GLEN COVE, N. Y. Treating sewage.

ROCHESTER, N. Y. Manually controlled apparatus at water works.

HUNTINGTON, N. Y. Automatic apparatus treating sewage.

OSWEGO, N. Y. Manually controlled apparatus on water supply.

ROME, N. Y. Automatic apparatus on water supply.

PORT WASHINGTON, N. Y. Manually controlled apparatus treating sewage.

SYRACUSE, N. Y. Manually controlled apparatus treating water.

CHARLOTTE, N. C. Automatic apparatus at Municipal Water Works.

CLEVELAND, O. Two units manually controlled apparatus at Municipal Water Works.

ROCKY RIVER, O. Manually controlled equipment treating sewage.

SCRANTON, PA. Fourteen units manually and automatically controlled equipment installed on various branches of the water supply system.

WILKESBARRE, PA. Twelve units manually and automatically controlled apparatus installed on various branches of the water supply system.

ESSINGTON, PA. Automatic apparatus installed treating sewage.

WARREN, R. I. Automatic apparatus installed treating sewage.

BRISTOL, PA. Automatic apparatus installed at Municipal Water Filtration Plant.

JOHNSTOWN, PA. Seven units of equipment installed on various branches of the water supply system.

PROVIDENCE, R. I. Manually controlled apparatus installed at Municipal Water Works.

CHARLESTON, S. C. Manually controlled apparatus installed at Municipal Water Works.

COLUMBIA, S. C. Two units manually controlled apparatus installed at Municipal Water Works.

DALLAS, TEX. Two units manually controlled apparatus installed at Municipal Filtration Plant.

AUSTIN, TEX. Two units manually controlled equipment installed at Municipal Water Works.

WHITEWRIGHT, TEX. Manually controlled equipment installed for treating sewage.

CHARLESTON, W. VA. Manually controlled apparatus installed at water works.

HUNTINGTON, W. VA. Automatically operated apparatus installed at water works.

NITRO, W. VA. Seven units of manual and automatically controlled apparatus installed treating water and sewage.

MILWAUKEE, WIS. Manually controlled apparatus installed at Municipal Water Works.

HUNTSVILLE, TEX. Automatic apparatus installed treating sewage.

WHEELING, W. VA. Three units manually controlled equipment installed at water works.

BUENOS AYRES, ARGENTINA. Two units manually controlled equipment installed at Municipal Water Works.

LIMA, PERU. Two units manually controlled equipment installed at Municipal Water Works.

HONOLULU, HAWAII. Five units of equipment installed on various branches of the water supply system.

PANAMA CANAL. Automatically operated apparatus installed at Miraflores and Mt. Hope water filtration plants.

GUATEMALA CITY, GUATEMALA. Manually controlled apparatus installed at Municipal Water Works.

HAVANA, CUBA. Four units manually controlled apparatus installed at Municipal Water Works.

OTTAWA, ONT., CANADA. Two units automatic apparatus installed at Municipal Water Works.

MONTREAL, P. Q., CANADA. Automatic apparatus treating sewage.

TORONTO, ONT., CANADA. Four units manually controlled apparatus treating water.

PETERBORO, ONT., CANADA. Automatically operated apparatus at Municipal Water Works.

CALGARY, ALTA., CANADA. Two units manually controlled equipment at Municipal Water Works.

EDMONTON, ALTA., CANADA. Manually controlled equipment at Municipal Water Works.

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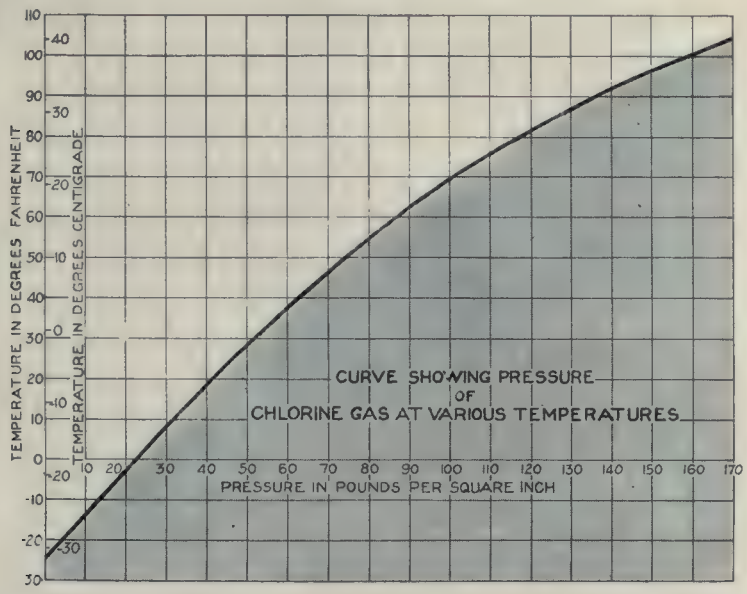
'W & T' apparatus is also used by the Red Cross Relief Expeditions in Palestine and in Greece and by the American Zionist Relief Unit in Asiatic Turkey.

'W & T' apparatus is extensively used in the sterilization of swimming pools, in industrial plants for the control of gases, and in many other fields of endeavor. Several lines of equipment are manufactured which are not discussed in this booklet, but which are mentioned in other publications available for gratuitous distribution upon request.

It is suggested, in order that prompt attention may be given to all inquiries, that communications from the Middle Western States and the western part of Canada be addressed to our Chicago office, Peoples Gas Building, Chicago, Ill., and that communications from European countries be sent to our representatives, The United Water Softeners, Ltd., of London, England. Prompt attention will be given to all requests for detailed information.

Chlorine Data

Chlorine [χλωρός = green], a greenish yellow gas, easily compressed to a liquid, was discovered in 1774 by Scheele, a Swedish chemist. Atomic weight 35.46, Molecular weight 70.92, Vapor density 35.8, Liquifies at −33.6° C (−28.48° F), Solidifies at −102° C (−151.6° F). Latent heat of evaporation = 121 B. T. U.


TEMPERATURE IN DEGREES FAHRENHEIT
TEMPERATURE IN DEGREES CENTIGRADE
CURVE SHOWING PRESSURE OF CHLORINE GAS AT VARIOUS TEMPERATURES
PRESSURE IN POUNDS PER SQUARE INCH

WEIGHTS OF CHLORINE

Datum	Gaseous Chlorine	Liquid Chlorine
Specific gravity	2.491 (Air = 1)	1.4405 (Water = 1)
Weight of 1 liter	3.167 grams	1440.5 grams
Weight of 1 cubic foot	0.198 pounds	89.922 pounds
Weight of 1 gallon	0.026 pounds	12.022 pounds

One volume of liquid chlorine is equivalent to 454.9 volumes of chlorine gas.

SOLUBILITY OF CHLORINE

Temperature		Solubility Ratio by Volume (Actual)	Pounds of Chlorine Soluble in One Million Gallons of Water (Practical)
C°	F°		
0	32	4.61	60,000
10	50	3.09	40,000
30	86	1.77	24,000

One part per million = 8.34 pounds per million gallons of water = 0.058 grains per gallon. One grain per gallon = 17.12 parts per million = 142.86 pounds per million gallons of water.

SUMMARY OF TYPES AND CHARACTERISTICS OF 'W & T' CHLORINATORS

Name and Type Designation	Limiting Capacities in Pounds of Chlorine per 24 hrs.		Ratio of Min. to Max. Flow of Chlorine per 24 hours for Accurate Control	Applicability	Point of Application	Method of Introducing Chlorine into Water or Sewage Being Treated	Limiting Pressure Against Which Chlorine Can be Applied	Remarks	Page
	Maximum	Minimum							
Manual Control Solution Feed Chlorinator. Type *MSA*	With Pulsating Meter 12 With Bubbling Meter 1.2	With Pulsating Meter 0.10 With Bubbling Meter 0.01	1/100	To any system wherein the chlorine solution can be introduced at a point other than in a main by gravity flow from the apparatus. There must be no pressure at the point of application except that which can be overcome by suitable elevation of the chlorinator. A water supply of 20 gals. per hour under a pressure of at least 15 lbs. must be available.	Into any channel, well or chamber into which the chlorine solution will flow by gravity. There may be any number of points of application as desired.	Through special flexible chlorine tubing. A distributing grid is sometimes attached to the end of the solution hose if it is desired to distribute the application over a wide space.	No pressure or only that which can be overcome by suitable elevation of the apparatus.		18-21
Manual Control Solution Feed Chlorinator. Type *MSAM*	Same as for Type *MSA*	Same as for Type *MSA*	1/100	To any system wherein the chlorine solution can be introduced in a main by gravity flow from the apparatus. There must be no pressure at the point of application except that which can be overcome by suitable elevation of the chlorinator. A water supply of 20 gals. per hour under a pressure of at least 15 lbs. must be available.	Into any main into which the chlorine solution may enter by gravity. There may be any number of points of application as desired.	Through special flexible chlorine tubing to a silver vulcanite solution shut-off and check valve inserted in the main through a 1/8-inch tapping.	Same as for type *MSA*	* When desirable to introduce chlorine against pressure, a W. & T. solution pump or a solution injector may be used in conjunction with this type of chlorinator. The water pressure available for operating the injector must be at least three times the pressure injected against.	18-21
Manual Control Solution Feed Chlorinator. Type *MSB*	200	1.0	1/5	Same as for Type *MSA*, except that a water supply of 50 gals. per pound of chlorine used and under a pressure of at least 20 lbs. must be available.	Same as for type *MSA*	Same as for type *MSA*	Same as for type *MSA*		22-25
Manual Control Solution Feed Chlorinator. Type *MSBM*	200	1.0	1/5	Same as for Type *MSAM*, except that a water supply of 50 gals. per pound of chlorine used and under a pressure of at least 20 lbs. must be available.	Same as for type *MSAM*	Same as for type *MSAM*, except that a 1/2-inch tapping in the main is required.	Same as for type *MSA*	See * type *MSAM*	22-25
Manual Control Direct Feed Chlorinator. Type *MDA*	300	1.0	1/5	To open bodies of water or sewage, 50 feet is the maximum depth below the surface at which the chlorine can be applied; 4 feet is the minimum.	Pump well, clear water basin, channel, gate chamber, etc. Chlorine may be piped as far as 200 yards from control panel to point of application.	Through standard 4-inch diffusors; capacity of each diffusor is 40 lbs. per 24 hours.	That due to 50-feet submergence of a diffusor.		26-28
Manual Control Direct Feed Chlorinator. Type *MDAM*	100	1.0	1/5	To water in mains where pressure does not exceed 25 lbs. per square inch.	Into any main where water pressure does not exceed 25 lbs. per square inch.	Through standard diffusor of either disc or pencil type. Single disc diffusors pass 50 lbs. gas per 24 hours and require 2-inch tapping in main. Twin disc diffusors pass 100 lbs. gas per 24 hours and require 2 1/2-inch tapping to main. Pencil diffusors pass 100 lbs. gas per day and require 1-inch tapping to main.	25 lbs. per square inch.	When desirable, an injector may be used. The water pressure available for operating the injector must be at least three times the pressure injected against.	28-31
Semi-Automatic Control Chlorinators.				Same as for comparable types of manual control apparatus.	Same as for comparable types of manual control apparatus.	Same as for comparable types of manual control apparatus.	Same as for comparable types of manual control apparatus.		32-34
Types *SASA*	12	1.0	1/12						
SASAM	12	1.0	1/12						
SASB	200	1.0	1/5						
SASBM	200	1.0	1/5						
SADA	300	1.0	1/5						
SADAM	100	1.0	1/5						
				NOTE.—With these types of chlorinators the flow of chlorine starts and stops automatically with the starting and stopping of the flow of water or sewage treated. The rate of flow does *not* vary with the variation in flow of water or sewage treated. Semi-automatic control can be obtained by means of a float, venturi tube, pitot tube, or a flow-operated vane mechanism.					
Automatic Control Chlorinators.				Same as for comparable types of manual control apparatus.	Same as for comparable types of manual control apparatus.	Same as for comparable types of manual control apparatus.	Same as for comparable types of manual control apparatus.	When float is used in conjunction with weir, maximum flow should give head over weir of from 4 inches to 6 inches. In conjunction with submerged orifice, minimum head must not be less than 1/2 inch and maximum head not more than 8 inches. When venturi tube is used, minimum differential head must not be less than 4 inches. Maximum pressure in venturi tube should not exceed 125 lbs. per square inch. When pitot tube is used, minimum velocity must not be less than 1/2 foot per second.	35-54
Types *ASA*	12	1.0	1/5						
ASAM	12	1.0	1/5						
ASB	200	1.0	1/5						
ASBM	200	1.0	1/5						
ADA	300	1.0	1/5						
ADAM	100	1.0	1/5						
				NOTE.—With these types of chlorinators, the flow of chlorine will vary automatically directly in proportion to the flow of water or sewage being treated. Automatic control can be obtained by means of a float, venturi tube, or pitot tube.					

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